University of Twente

# Circularity and Credit Risk in the Construction Industry

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# Acknowledgement

This research was conducted as part of my thesis to complete my bachelor's in Industrial Engineering and Management. The research was conducted with the Corporate Sector Coverage (CSC) team in ING's Wholesale Banking division, based in Amsterdam. The research was supervised by Devrim Yazan and Marcos Machado at the University of Twente.

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Jasper van Beurden

# Executive Summary

This thesis explores the relationship between circularity and default risk in the construction sector at ING. The primary objective of this study is to confirm that circularity practices have a de-risking effect on companies within the construction sector, since this is an effect that can be seen in other industries. Additionally, the research aims to assess whether this de-risking effect is currently considered in ING's risk assessments. Finally, based on the findings, a suggestion is made to include a circularity section in ING's risk assessments to enhance risk management practices.

The study employs a mixed-methods approach, combining quantitative analysis and qualitative insights. The qualitative insights are gathered through interviews with key stakeholders within ING's risk management and sustainability departments, providing a deeper understanding of the current risk assessment practices. The quantitative analysis focuses on a sample of construction companies within ING's portfolio and examines their circularity practices using the Circularity Transition Indicators, a set of indicators developed by the World Business Council for Sustainable Development, and their risk rating.

The findings of this study reveal a positive correlation between circularity practices and a reduction in default risk within the construction sector. This is because of the resource intensiveness of the construction sector, combined with the rising prices of raw materials and increased problems the global supply chain is facing. Companies that integrate circularity principles into their operations exhibit lower default risk indicators, including financial stability, resilience, and long-term viability. However, the analysis also highlights that ING's risk assessments do not currently explicitly consider the de-risking effect of circularity practices within the construction sector. This means that construction companies with better and more sophisticated circularity practices do not necessarily have a lower risk rating.

Based on these findings, it is recommended that ING incorporates a circularity section in its risk assessments to capture the potential de-risking effect of circularity practices. By integrating circularity considerations into risk assessments, ING can better identify and evaluate the default risk of construction companies, enabling more informed lending decisions and improved risk management.

Further research is suggested to expand the study by examining a larger sample of companies within the construction sector and exploring other industries. This would provide a more comprehensive understanding of the link between circularity and default risk across different sectors. Additionally, investigating the long-term financial performance and market competitiveness of companies embracing circularity practices would contribute to a more holistic assessment of their risk profile.

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# Table of abbreviations

| Abbreviation | Meaning |
|---|---|
| ESG | Environmental, Social, Governance |
| PD | Probability of Default |
| LGD | Loss Given Default |
| EAD | Exposure at Default |
| CSC | Corporate Sector Coverage |
| KPI | Key Performance Indicator |

# Reading guide

**Chapter 1: Introduction**

Chapter 1 is the introduction to the report. It provides information on the background of the research, briefly describes the methodology used and introduces the problem.

**Chapter 2: Literature review**

Chapter 2 uses existing literature and research to introduce the main topics discussed and investigated in this report.

**Chapter 3: Methodology**

Chapter 3 explains the methods used to solve the problem.

**Chapter 4: Case study**

Chapter 4 is where the methods are being applied in the form of a case study. This is where the data collection and analysis take place.

**Chapter 5: Results & discussion**

Chapter 5 discusses the results from the case study in detail.

**Chapter 6: Conclusion**

Chapter 6 is the final chapter in the report and provides a conclusion. The main findings from the research are summarised, the limitations are discussed, and recommendations are provided.

# 1. Introduction

The construction industry is the largest consumer of raw materials, using 50% of all raw materials in the Netherlands (Schuttelaar & Partners, 2018). As ING is increasingly focused on sustainability and helping their clients become more sustainable, they are interested in new ways in which they can promote and enhance sustainability with their clients in the construction sector. Considering the high raw material usage in the construction sector, transitioning to a circular economy is a key strategy in reducing the material consumption and therefore reducing the construction industry's environmental impact. This research, carried out in cooperation with ING, investigates how ING can encourage their clients in the construction industry to become more sustainable.

## 1.1 ING Group and Corporate Sector Coverage

ING is a global bank offering retail, direct, commercial, investment, wholesale, and private banking, as well as asset management and insurance services. They have over 37 million customers and are active in over 40 countries. In the Netherlands, ING has over 14,000 employees with over 600,000 commercial clients. ING is looking to cement their place as one of the leading sustainable banks in the world, and is therefore increasingly focused on helping their customers, both big and large, adopt sustainable business practices.

This research project is conducted for ING's Corporate Sector Coverage (CSC) team in the Netherlands. ING's CSC team consists of 6 relationship bankers who are supported by analysts. They cover ING's corporate clients across various industries and sectors, including industrial manufacturing, construction, building materials, retail (food and non-food), and services. The CSC team is responsible for managing the relationship with these clients and is also jointly responsible for customer due diligence, known as the Know Your Customer (KYC) process. To fall under ING's Wholesale Banking department, companies need to have an annual revenue of at least €250 million or be publicly listed. In the Netherlands, there are around 30 construction companies that fit this criteria, and in ING's CSC portfolio specifically, there are 6.

## 1.2 Problem identification and description

The CSC team at ING identified the construction industry as a particularly problematic industry in terms of transitioning to a more sustainable business model. The construction industry is resource and energy intensive, and being a more traditional industry, they are more reluctant to change their ways. The CSC team is therefore keen to learn and understand how they can better encourage and help their existing clients in the construction sector, as well as potential new clients, become more sustainable, with a particular focus on circularity. The CSC team and ING as a whole already have several sustainable finance solutions, but until now these are fairly limited in scope.

The construction industry is one of the largest users of natural resources and one of the leading contributors to greenhouse gas emissions, using 50% of raw materials in the Netherlands (Schuttelaar & Partners, 2018). Furthermore, the construction industry has been responsible for the most waste in recent years (Statistics Netherlands, 2019). Introducing circular economy principles could help change this. Recycling does already take place in the construction industry, but the current way of doing this means that most recycling that does take place takes place in the form of low level down-cycling, where the value of the material is not retained. An example of this is waste such as concrete being used for the foundations when roads are built. (Statistics Netherlands, 2019) This is therefore not considered circular, since the materials are not reused at their highest value (*Circular economy introduction*, (n.d.)). This means that this recycling does not significantly reduce raw material usage. Considering the amount of waste produced by the construction industry, the raw material usage could be reduced significantly if high level recycling, or upcycling, took place on a larger scale. This is especially relevant, since the Netherlands has set a goal of a completely circular

construction industry by 2050 (Ministerie van Infrastructuur en Waterstaat, 2021). On top of this, raw material processing is the most greenhouse gas intensive part of the construction value chain, other than the operation and use of the completed building (McKinsey & Company, 2022). Furthermore, a considerable amount of waste in the construction supply chain could be avoided through better management of the materials in the construction supply chain (Deng et al, 2019).

A key barrier to the implementation of circular principles in the construction sector is the financial barrier (Wuni, 2022). If there is no economic benefit, then the relevant actors in the construction supply chain will not be motivated to implement circularity into their practices in the absence of government regulations. The construction industry is such that several actors all need to implement circularity to fully take advantage of the benefits it can provide. Therefore, to successfully do this there needs to be economic motivation for the relevant actors in all parts of the construction supply chain, as well as sufficient communication between the different actors in the supply chain. Low cost of extracted materials, or primary materials, is one of the main reasons for the slow uptake of recycled secondary materials. Primary materials are the same price or cheaper than recycled materials (Gálvez-Martos, 2018). This means that in many cases, the use of secondary materials, which is much more desirable from a circularity perspective, is not economically viable for construction companies. This is where financial institutions, such as ING, can step in and provide economic motivation through sustainable finance solutions, which will be discussed next.

Sustainable finance refers to taking ESG into consideration when financial institutions make financing decisions (European Commission, n.d.). At ING, this currently takes place in several forms. This includes KPI based finance solutions. An example of this is giving a company requesting financing a series of ESG related KPIs, with at least one KPI for environment, one for social and one for governance. Depending on how the company performs on the different KPIs will determine whether the rate on the loan increases, decreases, or stays the same. This is a good way of encouraging companies to perform better in terms of sustainability, but also has its limitations. The company can have a big influence on the KPIs chosen, so this does not force the company to make changes where it is performing badly, and potentially where change is needed most. A company will not agree to sustainability targets that it knows it will not meet. Furthermore, it is difficult for companies to track the emissions and material usage in the entire construction supply chain (Dadhich et al., 2015).

There is big potential for sustainability and circularity to be further integrated in finance solutions when companies are seeking financing from banks. An interesting link to be further investigated is link between the circularity of a company and the company's risk of default. According to research from Zara & Ramkumar (2022), an increased level of circularity has a de-risking effect on a company. This is an interesting link, and one that can further be investigated for the construction industry. This de-risking effect of circularity can be explained by the fact that circular businesses reduce their exposure to the volatility in prices of raw materials (Zara, 2020), and can also reduce a company's dependence on suppliers (Gebhardt et al., 2022), which also allows construction companies to track greenhouse emissions associated with projects better.

Considering the apparent link between circularity and credit risk, this could be a way for financial institutions to further incentivize construction companies to embrace circular solutions, thus lowering their raw material usage and waste production. Lower risk means lower rates when companies are seeking finance. However, at ING, circularity is currently not considered in their credit risk assessments. This is partly due to lack of understanding between the link of circularity and risk, and partly because there is no standardized method of measuring circularity.

Having gained a better understanding of the issues faced by ING with regards to sustainable finance as well as the issues facing the construction industry, the following problems are identified:

- Limited implementation of circularity in the construction industry
- No insight into how circularity impacts risk at ING
- High use of raw materials
- High cost of recycled secondary materials
- Construction companies unwilling to spend more on secondary materials
- Limited economic motivation to implement circular business strategies
- Lack of “smart demolition”
- Limited availability of high-quality secondary materials
- Construction waste is downcycled
- Circularity is not considered in credit risk assessments at ING
- No standardized method to measure circularity of construction companies at ING

These problems are all related to each other, and these relationships are shown in a problem cluster in Figure 1 to identify the core problem. The problems are linked through causal relationships (check MPSM. Each problem is linked to its cause, and the knock-on effect this problem has. The problem without a cause is known as the core problem, and solving this will have a knock-on effect to the other problems in the cluster, helping solve those as well (Heerkens & Winden, 2021). The issues listed in the problem inventory and cluster are not the only obstacles the construction industry is facing with regards to circularity. Furthermore, this cluster focuses on the use of demolition waste and recycling in the industry when renovating is also an effective circular strategy. Furthermore, there are other problems that could also be listed and included in the problem cluster, but many of those problems are not easily influenced by financial institutions, so are therefore not included.

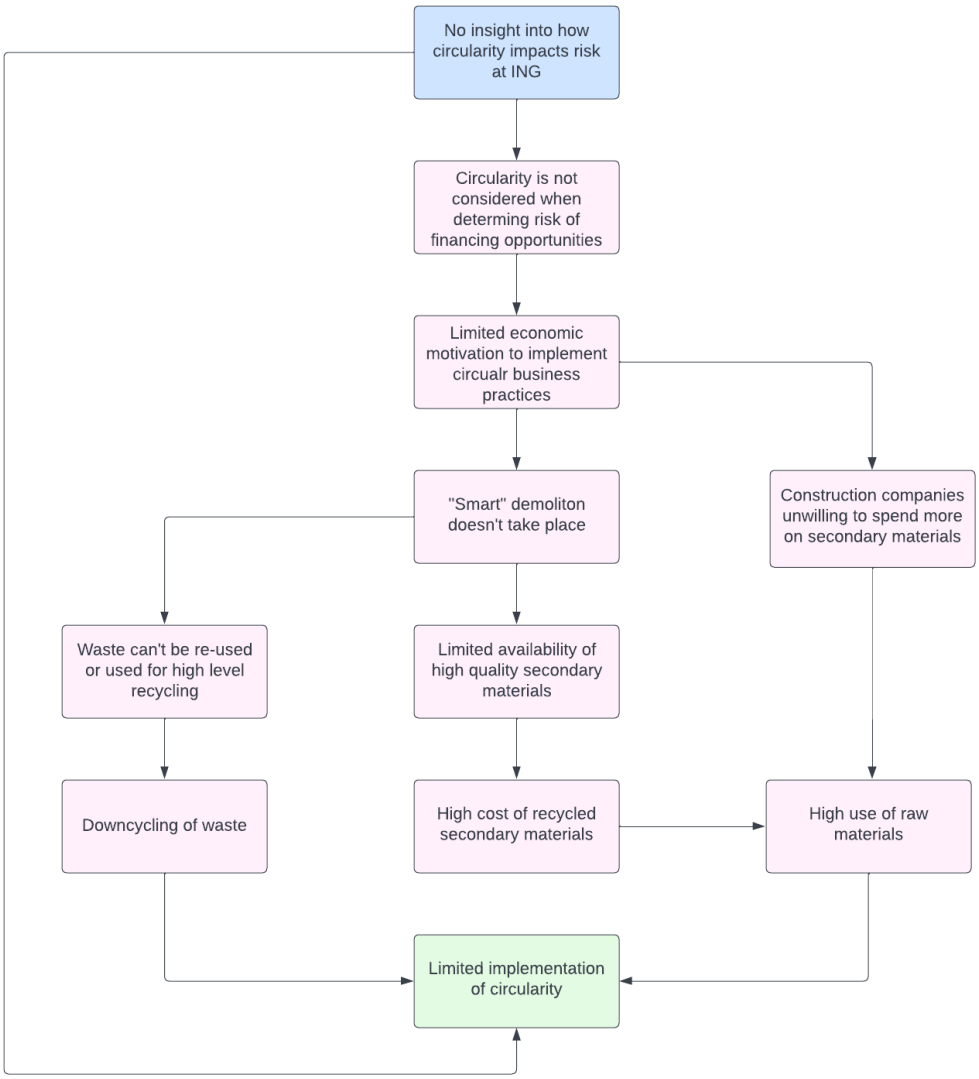


*Figure 1, problem cluster*

From this problem cluster, the core problem is identified as:

- No insight into how circularity and sustainability in construction ecosystems impacts credit risk at ING

The follow on from this problem is that circularity is not included in risk assessments at ING. If this was the case, becoming more circular would have major financial benefits to companies. This is the problem that will be researched and solved in this thesis.

## 1.3 Methodology

The research design used in this thesis is based on the Managerial Problem-Solving Method (MPSM) from “Solving Managerial Problems Systematically” by Hans Heerkens and Arnold van Winden. According to the MPSM cycle there are seven phases when trying to solve a managerial problem, which are:

1. Phase 1 – Defining the problem
2. Phase 2 – Formulating the approach
3. Phase 3 – Analyzing the problem
4. Phase 4 – Formulating solutions

5. Phase 5 – Choosing a solution
6. Phase 6 – Implementing the solution
7. Phase 7 – Evaluating the solution

Within each phase in the MPSM cycle, knowledge problems will be encountered which will be answered through a research cycle (Heerkens & Winden, 2021) as shown below:

1. Formulating the research goal
2. Formulating the problem statement
3. Formulating the research questions
4. Formulating the research design
5. Performing the operationalization
6. Performing the measurements (gathering data)
7. Processing the data
8. Drawing conclusions (reviewing the problem statement)

Phase 1 is done by taking a critical look at the problems facing the construction industry, with a focus on what the barriers to implementation are. From this, one core problem is chosen to focus on and find a solution to. Phase 2 is done by making a detailed plan to find a solution to the core problem identified. Phase 3 is conducted through a literature review, exploring, and understanding the specific problems and topics in detail. In phase 4, potential solutions are explored, and through interviews with ING employees, one of these solutions is chosen in phase 5. In phase 6, this solution is applied to the construction companies in ING's CSC portfolio, to understand whether this solution is viable. A critical look at the solution and its effectiveness is then looked at phase 7, where the solution is evaluated.

# 2. Literature review

Before diving further into the research, several key concepts need to be understood. This is done through systematic literature reviews, the results of which are summarized in this chapter.

## 2.1 Credit risk

Credit risk is defined as the inability or unwillingness of a customer or counterparty to meet commitments in relation to lending, trading, hedging, settlement, and other financial transactions. (Spuchľakova et al., 2015) Credit risk is typically determined as a combination of three factors: probability of default (PD), loss given default (LGD), and exposure at default (EAD). Banks, including ING, have their own internal models, which are calculated using the Advanced Internal Ratings Based (AIRB) approach, with the result of the credit rating being used to calculate the risk-weighted asset (RWA) (Balogh & Bolocon, 2010). The required capital the bank must hold is a fixed percentage of the RWA.

PD is fully influenced by a company's business model, with riskier business models leading to a higher PD. LGD and EAD are less about the business model of the company applying for a loan, and more about the nature of the loan. EAD is all about the size of the loan, also known as a bank's exposure at the time of default. A high exposure means the bank faces higher losses in case of default. LGD is also related to the bank's exposure, but factors in any losses that can be recuperated by the bank through collateral or other means. The lower the EAD and the LGD, the lower the risk of the deal is.

Since only PD is influenced by the business model of the company applying for a loan, PD is the aspect of credit risk that will be further investigated, using the finding from existing literature (Zara & Ramkumar, 2022) (Su et al., 2022) that increased levels of circularity in companies leads to a lower PD. While this relationship was found to be true for a large sample of companies in the literature

mentioned, this doesn't always have to be true. There are also risks associated with companies adopting circular business models, like high upfront costs and uncertainty in the business model (Dulia et al., 2021).

### 2.1.1 Probability of default (PD) model

A number of models exist for calculating the PD of corporations. These include statistical models that use accounting ratios and historical statistics to produce a probability, while structural models measure the probability that a company's assets become less valuable than their debts, at which point it becomes beneficial for the company to default.

Statistical models use a number of accounting and financial ratios to determine the financial health of a company. Most statistical models combine a number of ratios into a single score. Ratios commonly used include return on assets, liabilities as a percentage of assets, EBITDA as a percentage of liabilities, market to book value, etc. These ratios give an overview of a company's profitability and debt ratios, which can be a good indicator for PD (Brealey et al., 2019).

Structural models, like the Merton model of default (Brealey et al., 2019), try to predict the probability that a company will choose to default on their debt. A company would do this in the scenario that their assets become worth less than the debt they are repaying. The advantage of a structural model when compared to a statistical model is that structural models have a theoretical base (Brealey et al., 2019), but information regarding the value of their assets and their debt maturities is needed.

Before starting with data collection, how circularity could potentially be included in PD models can be investigated. In the case of statistical models, it would be relatively simple to include some circularity metrics. However, in order to successfully do this, sufficient historical data on how circularity impacts PD is needed. Including circularity in a structural model isn't as simple, as structural models revolve around the idea that company's may choose to default depending on the value of their assets. Therefore, upon initial inspection, structural models may not be the most appropriate models if circularity is to be included.

### 2.1.2 ING's internal rating model

At ING, their internal rating determines the PD, with each rating corresponding to a given PD similar to other rating systems like Moody's, S&P, or Fitch. This internal rating is based on a quantitative and qualitative section. The quantitative section considers financial metrics, requiring a number of different inputs. Based on this input, a statistical regression is performed, giving an initial rating, similar to the statistical methods described in section 2.1.1. Specific details on the financial metrics or the statistical regression models are not included in this report for confidentiality reasons.

Having determined the initial rating from the quantitative section, the qualitative section comes in. There are several different sections, each with their own respective weights. Depending on how a given company scores in these different sections, the initial rating from the quantitative section will be either increased (higher risk) or decreased (lower risk). Specific details on these qualitative factors are again not included for confidentiality reasons.

## 2.2 Link between circularity and credit risk

Several researchers have investigated the link between circularity and risk of default in the past, although there is little information on the link specifically related to the construction sector. However, the link between CE and finance is still a relatively new field of research, so limited literature is available. In this section the existing literature found will be discussed, as well as how this would apply to the construction sector.

In a study by Su et al. (2022), research was conducted on default likelihood based on resource extraction and emissions. Using a sample of 290 banks, this study finds that high emitters and resource extractors have a higher probability of default and suggests that banks can improve their financial performance by increasing their financial exposure to carbon neutral companies seeking loans (borrowers) (Su et al., 2022). Considering the resource intensiveness of the construction sector, it is reasonable to expect the trend found by Su et al. (2022) to hold in the construction sector as well.

A study by Zara & Ramkumar (2022) found that companies with higher circularity scores had a lower PD, in both the short and the long term. The de-risking effect is found to be greater in the long term than the short term. Based on a sample of 222 European companies in resource or energy intensive industries, the study found that companies with better circularity scores had a lower PD, on both a one-year and five-year time horizon (Zara & Ramkumar, 2022). Considering the construction industry is a resource intensive industry, one can expect this pattern to be seen in the construction sector as well. As with the research by Su et al. (2022), this study again does not explore the reasons behind the de-risking effect of circularity.

To summarize, there is some existing research on the link between circularity and credit risk, despite this being a relatively new field of research. There is more research on the link between ESG and financial performance, but this does not specifically focus on circularity. Both relevant pieces of literature found support the de-risking effect circularity has, with the research by Zara & Ramkumar (2022) focusing on resource intensive industries, like the construction industry. In both cases, the research does not explore the reasons behind the link. Therefore, the reasons circularity appears to have a de-risking effect will be explored through the use of historical data.

As already mentioned, the construction industry is one of the highest consumers of raw materials, using over 50% of all raw materials consumed in the Netherlands (Schuttelaar & Partners, 2018). This means that construction companies highly dependent on raw materials are also vulnerable to the volatile prices of raw materials and supply chain disruptions. Supply chain disruptions have become increasingly problematic in recent times, first due to the Covid-19 pandemic (Sombultawee et al., 2022), and then because of the conflict between Russia and Ukraine (Allam et al., 2022), with the latter also drastically increasing energy prices, another significant problem for construction companies. These supply chain disruptions are one of the contributing factors to the volatile and increasing prices of raw materials. The historical prices of several key construction materials are explored here, to investigate whether the supply chain disruptions discussed also translate to higher prices. If this is the case, this could help explain the de-risking effect circularity appears to have, since a circular company is less dependent on raw materials and is therefore not vulnerable to price increases.

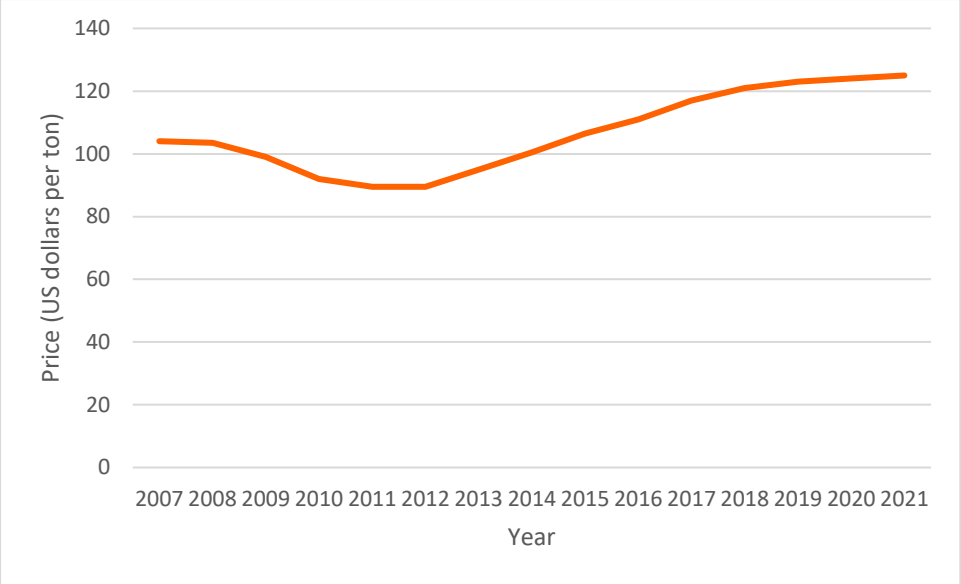


*Figure 3, cement price development (U.S. Cement Prices 2022 | Statista, 2022)*

While cement prices do not seem to be volatile from figure 3, prices have been steadily rising since 2012. Cement is the most used material in the construction sector, so the rising prices have a big impact on all construction companies. Closing the loop, which means using recycled concrete, would therefore be beneficial to construction companies, since they would no longer be dependent on the primary market which has seen significant price increases in recent years.

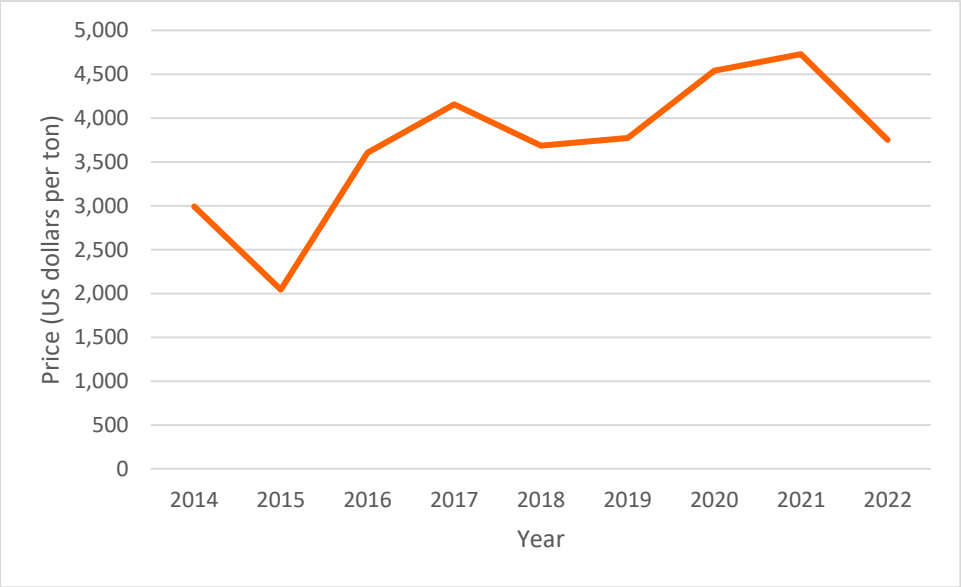


*Figure 4, steel price development (TRADING ECONOMICS, n.d.)*

Steel is one of the most used materials in the construction sector, and from figure 4 we can see that steel prices have been volatile since 2014, with the price coming in 2015 at $2,000 per ton, and peaking at over $4,500 per ton in 2021. This can cause serious problems for construction companies, as the volatile prices can lead to sudden unexpected extra costs, putting construction projects under financial pressure. On top of the volatility, the average price has also been rising in recent years, leading to higher costs.

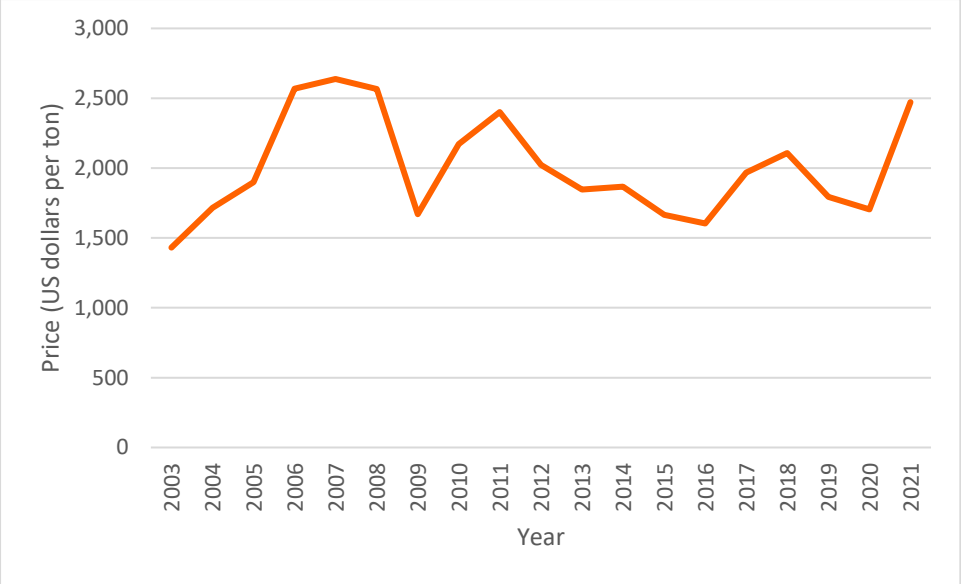


*Figure 5, aluminium price development (Statista, 2022)*

Aluminium prices have been volatile since 2003, without the average price increasing significantly, as can be seen in figure 5. The price has been fluctuating between $1,500 and $2,500 per ton from 2003 to 2021, which means that depending on when aluminium for a construction project is ordered, the price can vary significantly.

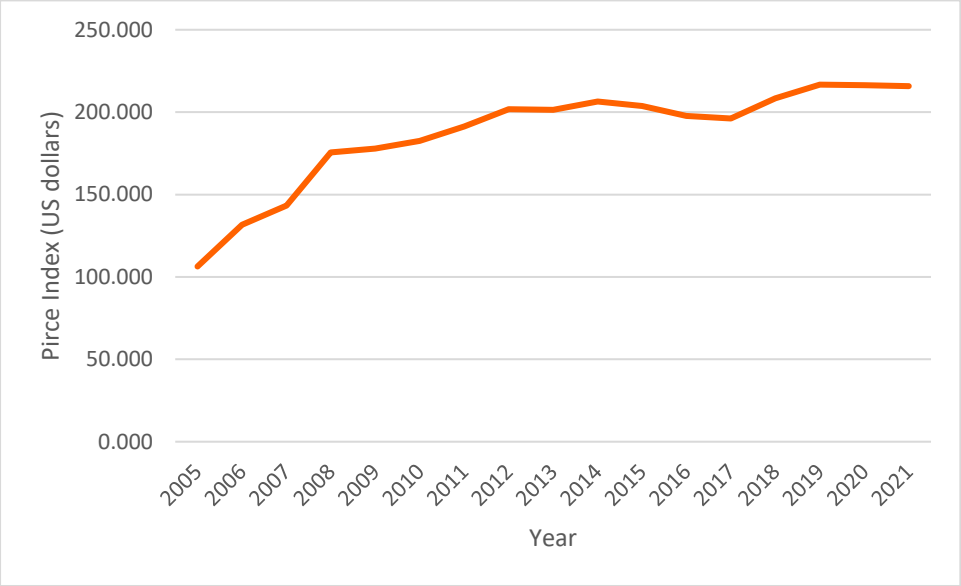


*Figure 6, asphalt price development (Producer Price Index by Industry: Asphalt Paving Mixture and Block Manufacturing: Asphalt and Tar Paving Mixture (Excluding Liquid), Including Bitumen or Asphalt Concrete, Asphalt Paving Cement, 2022)*

Asphalt prices have seen a steady increase from 2005 to 2021, without showing especially volatile behaviour, as can be seen from figure 6. Asphalt is one of the main materials used in infrastructure, so construction companies that are active in this area are dependent on asphalt prices. Asphalt reuse and recycling is starting to take place more but has not significantly decreased asphalt use.

To summarize, figures 3 and 6 show steady price increases for cement and asphalt in recent years, which puts pressures on the margins in construction projects. This therefore supports the apparent de-risking impact of circularity, as the price increases of these raw materials mean that re-using or

using recycled material is becoming more cost effective. Figures 4 and 5, on the other hand, show very volatile prices for steel and aluminium. In terms of risk, this can be more of a problem than steady price increases, which can be anticipated, as volatile prices can lead to higher-than-expected costs in construction projects. Figures 5 and 6 therefore also support the apparent de-risking effect of circularity.

# 3. Methodology

Based on the core problem identified in section 1.2 and the literature review in chapter 2, the main research question for this thesis is identified as:

- *How can circularity of construction companies be measured and integrated in risk assessments so that ING can enhance circularity in the construction industry?*

The methodology used to answer the research question is described here, including how this fits into the different phases of the MPSM (Heerkens & Winden, 2021).

The research question above can be split into two separate sub-questions:

1. *How can the circularity of construction companies be measured?*
2. *How can circularity be integrated in risk assessments?*

Question 1 needs to be answered first, with the results from this being used to answer question 2, and thus the whole research question.

To answer sub-research question 1, existing circularity metrics will be researched. This will be done through the following sub-research questions:

*1.1 What circularity metrics are currently available?*
*1.2 What are the strengths and weaknesses of each of these metrics?*

The sub-questions above are answered through desk research and existing literature. Answering these research questions corresponds to phase 4 of the MPSM cycle, formulating solutions (Heerkens & Winden, 2021).

Having answered these sub research questions, a circularity metric can then be selected, by considering the following sub-research question:

*1.3 Which metric is the most appropriate when trying to reflect on the financial effect of circularity?*

Answering sub-question 1.3 will result in selecting a circularity metric to proceed with, and answer sub-research question 2. This question will be answered with the help of a member of ING's sustainable finance team. This corresponds to phase 5 of the MPSM cycle, choosing a solution (Heerkens & Winden, 2021).

Having selected a circularity metric, the chosen metric is applied to the construction companies in ING's CSC portfolio. The data needed for the metrics is collected from the companies' annual reports. Following the data collection, a circularity score is calculated for each company. This corresponds to phase 6 of the MPSM, implementing a solution (Heerkens & Winden, 2021). Having calculated circularity scores, the following sub-research question is answered:

*1.4 Is there a link between circularity and risk rating under ING's current risk rating system?*

This is done through data analysis. First, an analysis on whether companies with better circularity scores already have lower risk ratings with ING's current risk rating. This corresponds to phase 7 of the MPSM, evaluating the solution (Heerkens & Winden, 2021).

Based on the results from this analysis, sub-research question 2 will be answered. This is done through interviews with relevant ING employees, during which the results from the data analysis are looked at. Based on the results from the data, how circularity can be included in risk assessments is discussed, after which recommendations are made to ING.

## 3.1 Limitations

One of the limitations of this research is the time constraint. I will be at ING to conduct my research for a total of 4 months, but alongside my thesis I will also be doing an internship, in which I will be doing other tasks. Alongside these other tasks, not related to my thesis, I will therefore make sure to collect all the necessary data that is needed for the research goal and will then finish the remaining part of the research and writing my thesis after leaving ING. This will allow me to get the most out of my time there. However, given how broad the topic of circularity is and how complicated the risk analysis process at ING is, the level of detail with which the problem is investigated is limited. I will solve this problem by focusing on a specific part of the problem and going into detail about this, and by focusing on a specific research population. This will leave room for further research on the topic at hand.

To provide insight into how circularity can be included in risk assessment, circularity scores with the chosen metric need to be calculated. This measurement and insight will be performed for construction and waste management companies in ING's corporate sector coverage portfolio of clients. Availability of data here could be an issue here. A list of relevant KPIs for circularity in the construction industry will be proposed, so ideally data for each KPI is needed. However, a complete data set is unlikely to be available for all, if any, of the companies. This is because companies don't always know exactly how they perform with regards to each KPI themselves, so in that case clearly the data won't be available for this project. However, since the research population will be ING's corporate sector coverage construction portfolio, I expect data to be available for at least some of the KPIs for each company, since all these companies are big or publicly listed. Since not all data will be available for the entire research population, it could be difficult to get a good impression of how good the proposed circularity measurement method is. This is therefore a limitation.

## 3.2 Reliability and validity

Reliability is concerned with the repeatability and consistency of the results. If research is repeatable, research conducted using the same research method would have the same or similar results (Heerkens & Winden, 2021). Repeatable and consistent results depend on the quality of the data. The main data collection that will take place will be done through interviewing construction companies, and this does pose some challenges in terms of reliability. The companies that will be interviewed are companies from ING's corporate sector coverage portfolio. To qualify for this portfolio, companies must have a revenue of at least €250 million or be publicly listed. The companies to be interviewed are therefore not reflective of the entire industry, and if someone were to interview a different set of companies, the results could differ. This means that the results are not repeatable for the entire construction industry. However, since this research is carried out in cooperation with ING's corporate sector coverage division, as long as the results are reliable for them than this doesn't have to be a problem. Therefore, reliability will be ensured by clearly stating for which population of companies the results of this research are targeted towards, and for which population the results will be reliable.

Validity is concerned with whether the outcome of the research is correct. There are three types of validity to be aware of: internal validity, external validity, and construct validity (Heerkens & Winden, 2021). How these three types of validity will be addressed in this research is discussed below.

Internal validity is concerned with the research design, and whether this has been properly constructed. Self-selection, meaning that participants in the research volunteer to take part, is the

main threat to the internal validity of research results (Heerkens & Winden, 2021). This is also the case in this project. The circularity of companies in the construction industry will be measured. This will most likely have to be done using public information, and companies which score badly in terms of sustainability and circularity may choose to not make this information available. It is therefore possible that I will be using a biased sample. Furthermore, I will be conducting interviews with construction companies as part of the research. The goal and scope of the research will be clearly communicated during the reach out, so the companies most likely to respond and participate in the interviews will be companies who are concerned about this topic. There is no way to get around this problem, so in order to ensure internal validity this problem will be clearly explained along with the limitations this poses to the research results.

External validity is concerned with whether the findings of a research project can also be applied to groups outside of the research population (Heerkens & Winden, 2021). In this research project, the focus is on measuring circularity within the construction industry. In order to ensure external validity, conclusions assumptions about whether the results from this research also hold for other industries or construction companies outside of the research population will not be made.

Construct validity is concerned with the operationalization of the concepts and constructs mentioned in the research (Heerkens & Winden, 2021). To ensure construct validity, the key concepts used in my research will be clearly defined. This includes all the concepts that are used and discussed in the problem identification phase of the research, as well as clearly defining the key performance indicators that will be identified in order to successfully measure the circularity of a construction company. By clearly defining these key concepts and constructs, construct validity will be ensured.

# 4. Case study

The goals of the case study are twofold:

1. Identify the best existing metric to use when trying to determine to what extent a company's circular practices have a de-risking effect.
2. Determine whether including a circularity section in ING's credit ratings would better reflect a company's true probability of default or if circularity is already somehow reflected.

To achieve these goals, first several metrics are investigated. From this, one metric is chosen to proceed with. A deep dive into this metric is then performed, with input from relevant ING employees. Having selected a metric, this metric is then applied to the construction companies in ING's CSC portfolio. The companies used in the case study are shown in Table 1. For explanation about the CL credit ratings shown in table 1 refer to section 2.1.2 and figure 2. For sake of confidentiality, the credit ratings are scaled from 0 to 1 according to the following formula:

$$z_i = \frac{x_i - x_{min}}{x_{max} - x_{min}}$$

| Company name | Company description | Scaled internal credit rating |
|---|---|---|
| Company A | Holding company with technical services, construction, and infrastructure entities. | 0.2 |
| Company B | Listed construction company specialising in property development, construction, technical services, and infrastructure. | 0.2 |
| Company C | Construction company active in the built environment and infrastructure. | 1 |
| Company D | Family construction business focusing on the built environment, infrastructure, and maintenance and renovation. | 0.2 |
| Company E | Listed company focusing on construction, technical services, and civil engineering. | 0.2 |
| Company F | Listed Dutch construction company comprised of 120 subsidiaries specialising in construction, real estate development, telecom, mechanical and electrical installations, civil engineering and infrastructure. | 0 |

*Table 1, ING's CSC construction portfolio companies*

Once the metric is applied to the construction companies, an analysis is performed to determine whether under ING's current risk ratings, companies with better circularity scores have a lower risk rating. This will determine whether including a circularity section using the selected metric in ING's risk rating methodology would be beneficial in better reflecting the probability of default of construction companies. The focus of this case study is first exploring a range of different circularity metrics to determine which is best for reflecting financial risk, and the second being to investigate whether it is worth including a circularity section in ING's risk assessments.

## 4.1 Semi-structured interviews

To further understand the problems the construction industry has with the implementation of circularity, several interviews were conducted, with ING employees as well as with construction companies in ING's CSC portfolio. The findings of the interviews are summarised in this section.

Two interviews were carried out. The plan was to interview relevant employees within ING, as well as the construction companies in the CSC team's portfolio. Response from ING employees were

positive, and employees were more than willing to take part, but with the companies the responses were less successful, with only one response from the six companies in the CSC portfolio. The purpose of the interviews is mainly to serve as a confirmation of the findings and trends discussed in the literature review conducted in chapter 2. The limited responses from construction companies is a limitation, however this research is a starting point for ING that they can expand on later with construction companies in different countries and different sectors.

The interview that was carried out, with Company A did confirm the findings from chapter 2. While they themselves were honest about not being leaders on the circularity front, they realise that it's becoming more and more important to change, due to both increasing regulatory requirements and price increases. For Company A specifically, the slow uptake is partly due to the way in which they are run. Company A is a holding company, with several smaller companies underneath it, with each company having its own management and culture. It is therefore difficult for them to implement policies across all their companies.

## 4.2 Circularity metrics

To be able to include circularity in ING's risk assessments, an overview of how a particular business is performing in terms of circularity is needed. From the literature review in chapter 2, it was discovered that this can be done through a variety of different metrics. An overview of a selection of these circularity metrics is provided below:

- Circle Assessment by Circle Economy
- Circular Transition Indicators (CTI) by WBCSD supported by KPMG
- Circulytics by Ellen MacArthur Foundation
- CIRCelligence by Boston Consulting Group (BCG)

A more detailed look at these metrics is provided below. This will be used to decide which metric is best suited to the needs of this project, which will then be to measure the level of circularity of the construction companies in ING's Wholesale Banking portfolio.

### 4.2.1 Circle Assessment

The Circle Assessment is a digital self-assessment tool that can be used to understand how a company's circular practices match up to their goals (Circle Economy & PACE, 2020). This means that the Circle Assessment is most suited for internal use at companies, as it allows them to determine whether they are on track to meet their circularity goals. In this research project, the impact of circularity on financial performance is investigated, so this metric is not the most suitable one in this case. Since this is a digital assessment, no detailed methodology report is available online, and more detail about the specific KPIs included in this assessment is not provided.

### 4.2.2 Circular Transition Indicators (CTI)

The CTI is a self-assessment framework to understand to what extent companies are closing loops, optimizing material flows, and creating value from their resources. It was developed by the World Business Council for Sustainable Development with support from KPMG and launched in 2020. The CTI is a quantitative metric system, providing insight into resource optimization and the link between circularity and business performance (Circle Economy & PACE, 2020). Considering the insight the CTI provides in the effect of a company's circularity on its business performance, this metric could be a good fit in this project, if the data required for the CTI is available from construction companies. The CTI manual, explaining in detail how scores for the different KPIs are calculated, is provided in appendix A.

### 4.2.3 Circulytics

Circulytics provides information on the extent to which a company has achieved overall circularity via a scorecard (Circle Economy & PACE, 2020). This indicator therefore provides an insight into the circularity of an organization as a whole, with other metrics focusing on specific products or materials. Circulytics provides a wide range of indicators, divided into 11 different themes. An overview of all these metrics is provided in appendix B.

### 4.2.4 CIRCelligence

CIRCelligence is a metric developed by the Boston Consulting Group and launched in 2020. It allows a company to deep dive into circularity, but therefore requires much more data and input than some other metrics. Furthermore, this metric and its corresponding methodology is reserved for BCG's clients, so cannot be used for this research project. Since it also requires more data than other metrics, this tool would not be chosen even if it were openly available (Circle Economy & PACE, 2020). Since this metric is not publicly available no more information on its methodology can be provided.

## 4.3 Selecting a metric

Based on the discussions above, the CTI is selected as the most appropriate metric of the six that were considered. The CTI provides insight into the impact the level of circularity of a company has on its business and financial performance, which the other indicators do not. Considering the goals of this project, which is to investigate how circularity impacts risk, which can also be seen as looking at how circularity impacts the business performance of construction companies. The CTI provides insight into exactly this, making it the most suitable metric. Furthermore, the CTI also allows the user to choose what KPIs to include and exclude, meaning that lack of some data isn't an issue. The CTI is also a free-to-use and openly available metric, which not all the metrics investigated are, making it the best choice overall. The KPIs are described and discussed briefly in section 4.4. The CTI manual is included in Appendix A for a more detailed overview of the KPIs and how they are calculated.

## 4.4 Circular Transition Indicators (CTI)

The CTI methodology and indictors are discussed in more detail in this section. The CTI is divided into four modules, as seen in figure 7.

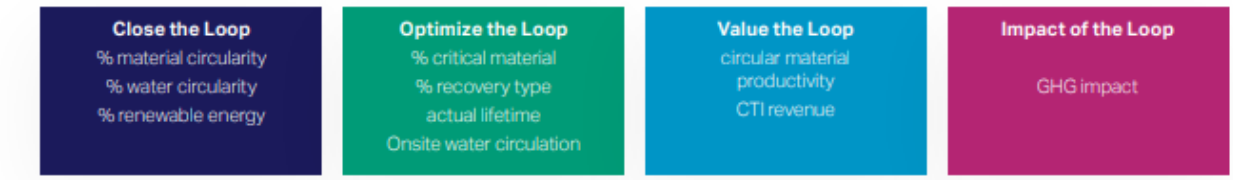


*Figure 7, (World Business Council for Sustainable Development & KPMG, 2022)*

The first module, Close the Loop, is comprised of three separate indicators:

- % material circularity
    - Weighted average of circular inflow and circular outflow
- % water circularity
    - Average of circular water inflow and circular water outflow
- % renewable energy
    - Percentage of total energy used coming from renewable energy sources

How values for each indicator are calculated can be found Appendix A. The Close the Loop module assesses how dependent a company is on linear inflow, whether that's linear materials, water or energy (non-renewable).

The second module, Optimize the Loop, provides insight on material criticality, with critical materials being taken from the list of critical materials as defined by the European Commission (European Commission, 2023). This module also provides insight into the efficiency of resource use at companies, and does this through the following indicators:

- % critical inflow
    - Percentage of raw materials used that are defined as critical.
- % recovery type
    - Breakdown of recovery type of circular outflow (reused/repaired, refurbished, recycled, biodegraded).
- Actual lifetime
    - The lifetime of a product compared to industry average.
- Onsite water circulation

How the values for the indicators can be calculated can be found in Appendix A.

In the CTI manual, this module is described as optional. This is because collecting the required data for this module can be challenging for companies, and this is also the case in the construction industry.

The third module, Value the Loop, provides insight into the additional value being generated from a company's circular economy initiatives and practices. This is done through the following indicators:

- Circular material productivity
    - Provides insight into how financially dependent a company is on linear inflow.
- CTI revenue
    - Company revenue adjusted for % material circularity.

This module is also described as optional in the CTI manual but given the nature of this research and the link between circularity and financial risk, the added value circularity has on a business is very relevant. Furthermore, the data from the Close the Loop module is reused here, in combination with company revenue, which is readily available for all the companies that are studied as part of this research.

The final module, Impact of the Loop, provides insight into the impact a company has on the environment, and to what extent their circular business practices is minimizing this. This is done through the following indicator:

- GHG impact
    - Indication of the GHG savings a company may see if they were to be 100% circular.

This module is described as optional in the CTI manual, and considering that this module is about showing companies the impact they could have if they were fully circular as opposed to the impact they are having, this module isn't relevant for the purposes of this research.

## 4.5 KPI selection

All the KPIs from the CTI were discussed with relevant employees at ING. Based on the results from these interviews, along with an initial check on data availability for the KPI in question, a decision is made on whether or not to include a KPI. The results from the interviews are shown in table 2.

| **KPI** | **Expert feedback on relevance of KPI** | **Comments on data availability (if relevant)** |
|---|---|---|
| % material circularity | Very relevant, as raw materials make up a large part of the costs in any construction project. | Data for this KPI appears to be readily available in annual reports. |
| % water circularity | Not very relevant from a financial perspective, as water costs do not make up a significant part of costs. | No data for water usage and circularity can be found in annual reports looked at. |
| % renewable energy | Not relevant from a financial perspective yet since no price difference, but with increasing regulations with regards to CO2 emissions is becoming more and more important for construction companies being ready for the future. | |
| % critical inflow | Relevant, but depends on definition of critical materials and on level of use in the construction industry. | Since the majority of materials used in the construction industry are not defined as critical by the European Commission, no data about this is available in annual reports. |
| % recovery type | Relevant, but depends on definition of critical materials and on level of use in the construction industry. | No data about this is available in annual reports. |
| Actual lifetime | From a circularity standpoint the lifetime of a product is very important to consider, but in the construction industry it's hard to know the lifetime at time of construction. | Very little data related to this can be found in annual reports. |
| Onsite water circulation | Not very relevant from a financial or risk perspective, as water is not one of the main costs associated with construction projects. | |
| Circular material productivity | This is relevant, as can show the direct financial benefits of using circular products. | Data on circular and sustainable materials used is available in annual reports. |

| | | |
|---|---|---|
| CTI revenue | Relevant, as this shows to what extent a company can translate their circular business activities into revenue. | Only extra data needed for this is financial data, which is readily available in annual reports. |

*Table 2, Interview results*

**Chosen KPIs**

Based on the results from the interview results in table 2, the KPIs that could be relevant in terms of having an impact on financial performance and risk are:

- % material circularity
- % renewable energy
- % critical inflow
- % recovery type
- Circular material productivity
- CTI revenue

However, after taking an initial look at the data that is currently available from the construction companies in ING's portfolio, several KPIs cannot be calculated with the current data availability (shown in table 2), so the final selection of KPIs is:

- % material circularity
- Circular material productivity
- CTI revenue

This list of KPIs is chosen only because of the lack of data for the others. Should more data be available in the future, it is proposed to include more KPIs.

## 4.6 Data collection and analysis

Since all the companies that will be studied are part of ING's CSC portfolio, all the companies are either publicly listed or have a revenue of at least €250 million. For the purposes of this research, that's a benefit, since it means that all the companies have detailed annual reports containing sustainability data and means that interviews did not have to be performed for data collection purposes. All data collected is collected from each company's respective 2021 annual reports.

The following data points are needed to calculate the CTI KPIs:

- Linear inflow
- Linear outflow
- Circular inflow
- Circular outflow
- Revenue

Based on data availability, several assumptions are made so that the relevant calculations can be made:

- Circular outflow is assumed to be recycled waste, or mass of waste separated.
- Mass of linear inflow is not available in many cases, but cost of linear inflow is. Therefore, average cost of raw materials will be taken to calculate the mass of linear inflow, with the average cost assumed to be €1,000 per ton of raw material. This is based off of company E's annual report, in which they list the total amount of raw material used and the total cost of

this. This assumption is made because all of the companies operate primarily in the Netherlands, where average cost of raw materials is expected to be similar for all companies.

- Circular inflow is estimated from mass of circular materials used explicitly mentioned in the annual reports. Circular materials are defined as recycled materials, or as other forms of sustainable material such as timber sourced from sustainably managed forests.

These assumptions are not necessarily fair assumptions to make, but the purpose of this section is to illustrate the potential methods for quantifying circularity Due to insufficient data, these assumptions are necessary. The results from the CTI calculations are therefore only used to show what an inclusion of circularity in risk assessments could look like, and do not necessarily truly reflect how the companies are performing in terms of circularity. If circularity were to be included, more data could be requested from the companies, but in the case of this research that was not done, partly because of the lack of responses from the companies approached. Furthermore, it is also unlikely that companies would hand over data not in their annual reports for a research project that has no direct benefit to them. If a bank they were looking to secure financing from requested this data, the companies in question would be much more likely to cooperate.

The exact assumptions and estimations made for each company are listed under each company's respective section.

### 4.6.1 Company A

| **Data from annual report FY21** | **Performance** |
|---|---|
| Waste (ton) | 53000 |
| Waste per million € (ton) | 24.2 |
| Percentage waste separation | 78.90% |
| Percentage sustainable timber | 99% |
| Cost of raw materials (€k) | 657,142 |
| Estimated mass (tons) | 657,142 |
| CO2 per million € (tons) | 11 |
| Revenue | 2,086,815 |

*Table 3, Company A data*

**Estimations and assumptions**

- Circular outflow is taken as waste separation percentage.
- No mention of circular inflow anywhere, so assumed to be 0.
- Cost of 1 ton raw materials is €1,000.

**CTI performance**

| **CTI KPI** | |
|---|---|
| % Circular inflow | 0 |
| % Circular outflow | 78.90% |
| Material circularity | 5.89% |
| Circular material productivity | 3.1755922 |
| CTI revenue | 122882.95 |

*Table 4, Company A CTI performance*

### 4.6.2 Company B

| Data from annual report FY21 | Performance |
|---|---|
| Total quantity of residual materials (ton) | 25,197 |
| Separation of residual materials | 81% |
| Reuse of residual materials | 88% |
| Asphalt recycling | 67% |
| Concrete recycling | 75% |
| Sustainable wood | 99.80% |
| Revenue | 1,748,000 |

*Table 5, Company B data*

**Estimations and assumptions**

- Cost of 1 ton raw materials is €1,000.
- Circular inflow taken to be reused material and wood, which is seen as a sustainable material, as this is all that is mentioned in annual report.
- Circular outflow is % of waste reused.

**CTI performance**

| CTI KPI | |
|---|---|
| % Circular inflow | 4.15% |
| % Circular outflow | 88% |
| Material circualrity | 7.00% |
| Circular material productivity | 2.519898 |
| CTI revenue | 122327.1 |

*Table 6, Company B CTI performance*

### 4.6.3 Company C

| Data from annual report FY21 | Performance |
|---|---|
| Separation percentage | 74% |
| Mass of wood (tons) | 1458 |
| Waste/revenue (tons) | 19.6 |
| Revenue | 1,041,471 |

*Table 7, Company C data*

**Estimations and assumptions**

- Cost of 1 ton raw materials is €1,000.
- Circular inflow taken to be wood, which is seen as a sustainable material, as this is all that is mentioned in the annual report.
- Circular outflow is taken as the separation percentage.

**CTI performance**

| CTI | |
|---|---|
| % Circular inflow | 1.08% |
| % Circular outflow | 74% |
| Material circularity | 9.75% |
| Circular material productivity | 7.7356295 |
| CTI revenue | 101,532.6 |

*Table 8, Company C CTI performance*

### 4.6.4 Company D

| Data from annual report FY21 | Performance |
|---|---|
| Recycling percentage | 80% |
| Asphalt recycling | 44% |
| Percentage waste reduction per euro revenue | 3.70% |
| Mass of waste reduction (tons) | 18.096 |
| Waste mass (tons) | 26,777 |
| Costs of raw materials | 322,140 |
| Revenue | 1,610,700 |

*Table 9, Company D data*

**Estimations and assumptions**

- Cost of 1 ton raw materials is €1,000.
- Circular input assumed to be recycled material use as mentioned in annual report.
- Circular outflow taken as recycling percentage.

**CTI performance**

| CTI | |
|---|---|
| % Circular inflow | 2% |
| % Circular outflow | 80% |
| Material circularity | 8.00% |
| Circular material productivity | 5 |
| CTI revenue | 128,934.6 |

*Table 10, Company D CTI performance*

### 4.6.5 Company E

| Data from annual report FY21 | Performance |
|---|---|
| Excavation waste (kilotons) | 2,146 |
| Demolition waste (kilotons) | 773 |
| Construction waste (kilotons) | 80 |
| Recylce/ reuse rate constrcution waste | 77% |
| Total concrete use (m^3) | 282,500 |
| Total timber use (m^3) | 18,000 |
| Total asphalt use (tons) | 1,050,000 |
| Total steel use (tons) | 84,000 |
| % Sustainable concrete | 7.00% |
| % sustainable timber | 99.00% |
| % Sustainable asphalt | 46.00% |
| % Sustainable steel | 68.00% |
| Revenue | 7,315,281 |

*Table 11, Company E data*

**Estimations and assumptions**

- Circular inflow taken as sustainable material consumption as listed in annual report.
- Circular outflow taken to be reuse/recycling rate.

**CTI performance**

| CTI | |
|---|---|
| % Circular inflow | 33.49% |
| % Circular outflow | 77% |
| Material circularity | 35.34% |
| Circular material productivity | 6.1045758 |
| CTI revenue | 2,585,267.1 |

*Table 12, Company E CTI performance*

### 4.6.6 Company F

| Data from annual report FY21 | Performance |
|---|---|
| % sustainable wood | 99% |
| % spearation | 96% |
| Recycling percentage | 99% |
| Waste (tons) | 777,000 |
| % secondary cement | 11% |
| % secondary asphalt | 42% |
| Cost of raw materials and consumables (EUR k) | 1,012,000 |
| Revenue | 6,103,000 |

*Table 13, Company F data*

**Estimations and assumptions**

- Cost of 1 ton raw materials is €1,000
- Circular inflow taken as explicitly mentioned sustainable materials used.
- Circular outflow taken as recycling percentage.

**CTI performance**

| CTI | |
|---|---|
| % Circular inflow | 7.66% |
| % Circular outflow | 99% |
| Material circularity | 47.33% |
| Circular material productivity | 6.0306324 |
| CTI revenue | 2888749.8 |

*Table 14, Company F CTI performance*

## 4.7 Data availability

Data availability was an issue in calculating CTI scores for each company, with Company E having the most complete data set. For each company other E, mass of raw materials had to be estimated from the cost of raw materials. Furthermore, circular inflow for each company is likely higher than the mass used to calculate the % circular inflow in each case, because only circular inflow explicitly mentioned was used, with other circular materials likely also being used. There are also some inconsistencies with circular outflow data. For each company, there was data about either percentage of waste recycled, reused, or separated. However, these are all considered to be a different level of circular, with reuse being most desired. Ideally, this difference would be reflected in the results, but with how the CTI is currently set up and with the limited data available, a distinction between these different levels of circularity cannot be made.

## 4.8 Data analysis

Graphs comparing ING's risk rating for each company and each company's KPI performance is shown here.

All data was scaled from 0 to 1 using the following formula:

$$z_i = \frac{x_i - x_{min}}{x_{max} - x_{min}}$$

Trends can be analysed and compared more clearly in this way.

### 4.8.1 % circular inflow

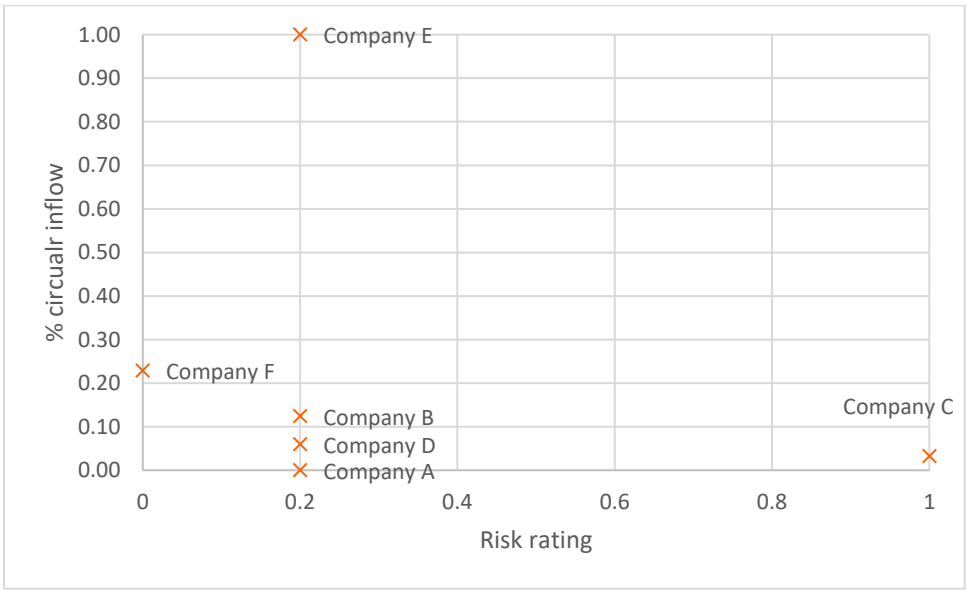


*Figure 8, % circular inflow*

| Company name | % circular inflow | Scaled rating | Scaled % circular inflow |
|---|---|---|---|
| Company A | 0 | 0.2 | 0.00 |
| Company B | 4.15% | 0.2 | 0.12 |
| Company C | 5.02% | 1 | 0.15 |
| Company D | 2% | 0.2 | 0.06 |
| Company E | 33.49% | 0.2 | 1.00 |
| Company F | 7.66% | 0 | 0.23 |

*Table 15, % circular inflow*

No trend can be seen here. High risk rating performs better than 3 with a lower rating, and there is a big variation within the 4 companies with the same risk rating.

### 4.8.2 % circular outflow

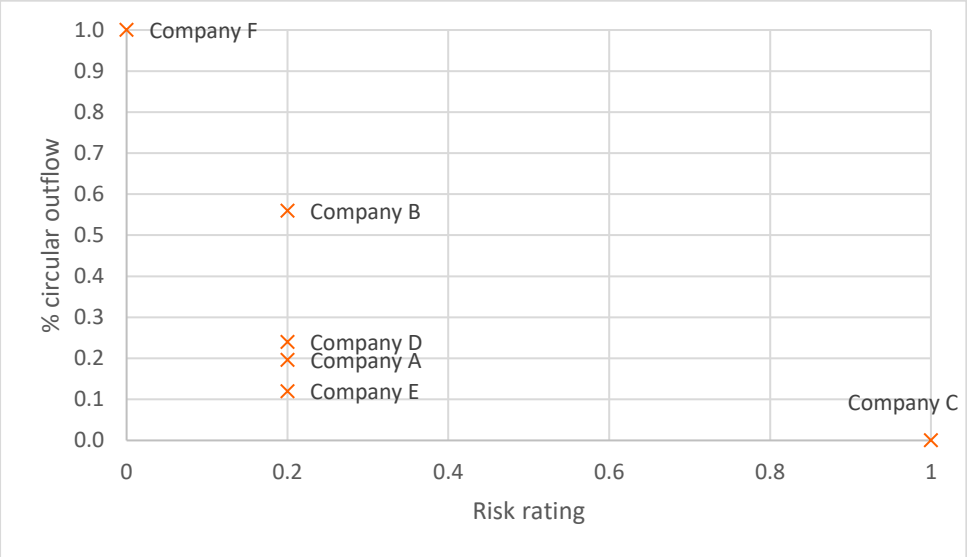


*Figure 9, % circular outflow*

| Company name | % circular outflow | Scaled risk rating | Scaled % circular outflow |
|---|---|---|---|
| Company A | 78.90% | 0.2 | 0.20 |
| Company B | 88% | 0.2 | 0.56 |
| Company C | 74% | 1 | 0.00 |
| Company D | 80% | 0.2 | 0.24 |
| Company E | 77% | 0.2 | 0.12 |
| Company F | 99% | 0 | 1.00 |

*Table 16, % circular outflow*

A slight trend can be seen here, with highest risk rating performing worst and lowest risk rating performing best.

### 4.8.3 Material circularity

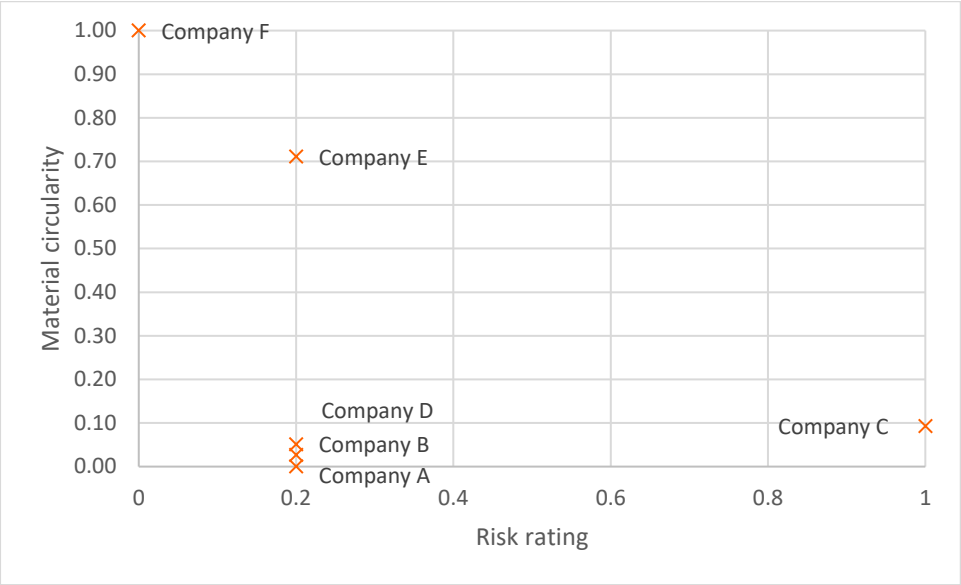


*Figure 10, material circularity*

| Company name | Material circularity | Scaled risk rating | Scaled material circuarity |
|---|---|---|---|
| Company A | 5.89% | 0.2 | 0.00 |
| Company B | 7% | 0.2 | 0.03 |
| Company C | 14.10% | 1 | 0.20 |
| Company D | 8% | 0.2 | 0.05 |
| Company E | 35.34% | 0.2 | 0.71 |
| Company F | 47.33% | 0 | 1.00 |

*Table 17, material circularity*

No trend can be seen here. Big variation in companies with same risk rating.

### 4.8.4 Circular material productivity

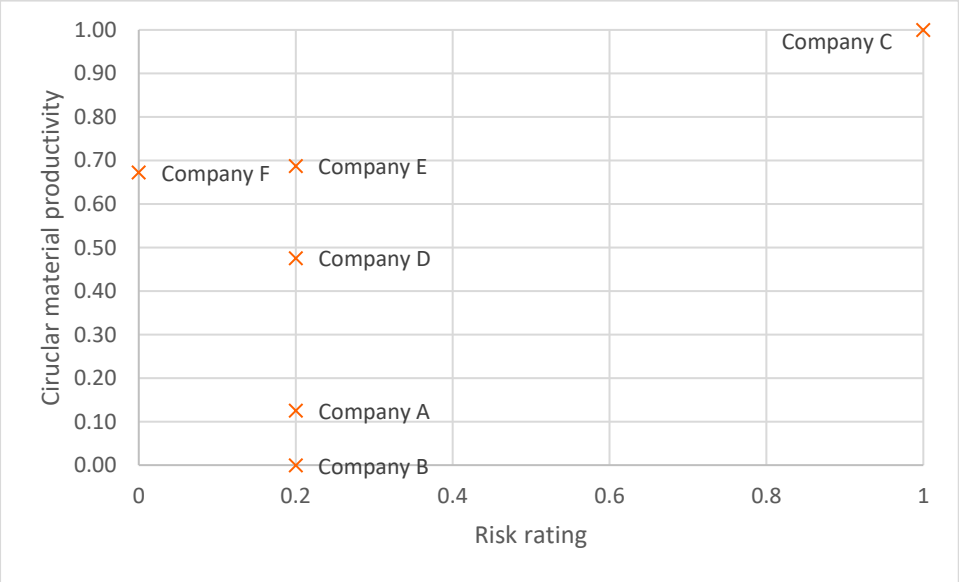


*Figure 11, circular material productivity*

| Company name | Risk rating | Circular material productivity | Scaled risk rating | Scaled circular material productivity |
|---|---|---|---|---|
| Company A | 10 | 3.18 | 0.2 | 0.13 |
| Company B | 10 | 2.52 | 0.2 | 0.00 |
| Company C | 14 | 7.74 | 1 | 1.00 |
| Company D | 10 | 5.00 | 0.2 | 0.48 |
| Company E | 10 | 6.10 | 0.2 | 0.69 |
| Company F | 9 | 6.03 | 0 | 0.67 |

*Table 18, circular material productivity*

No trend can be seen here, with a big variation in performance for companies with the same risk rating.

### 4.8.5 CTI revenue

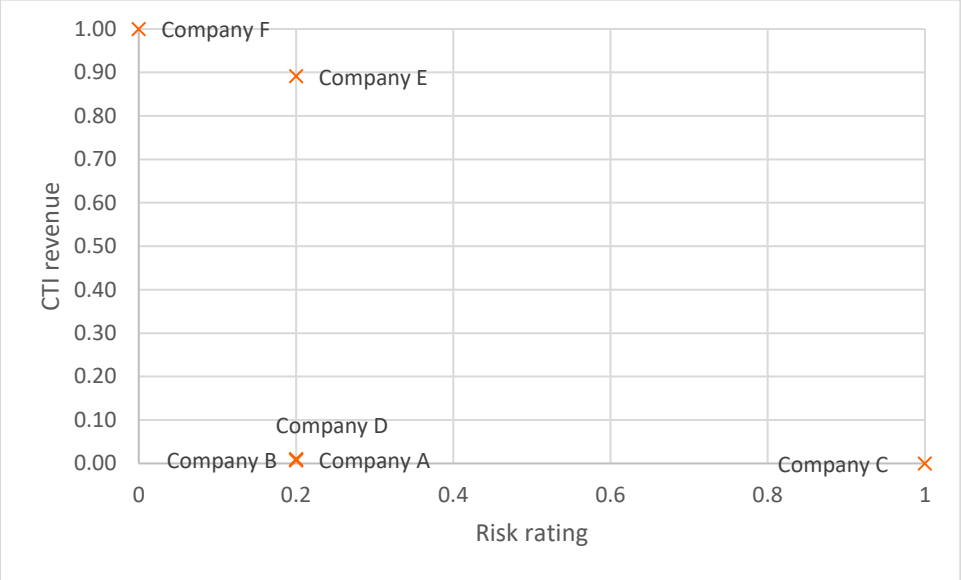


*Figure 12, CTI revenue*

| Company name | Rating | CTI revenue | Scaled Rating | Scaled CTI revenue |
|---|---|---|---|---|
| Company A | 10 | 122882.95 | 0.2 | 0.00 |
| Company B | 10 | 122327.1 | 0.2 | 0.00 |
| Company C | 14 | 146857.88 | 1 | 0.01 |
| Company D | 10 | 128934.6 | 0.2 | 0.00 |
| Company E | 10 | 2585267.1 | 0.2 | 0.89 |
| Company F | 9 | 2888749.8 | 0 | 1.00 |

*Table 19, CTI revenue*

The expected trend is seen here to some extent, but three companies with a lower risk rating score the same as company C, which raises some doubt over the reliability of the trend.

# 5. Results & discussion

## 5.1 Results

Expected trend is only seen in one of the graphs (6.3.2). A statistical analysis is not performed because the sample for which data is collected is too small. This means that circularity is currently not seen back in ING's risk rating system. While it was known that circularity isn't explicitly included in ING's risk rating already, it was possible that circularity was in some way reflected in better financial performance, which would then in turn result in a lower risk rating. The graphs suggest that this is not the case, which has multiple implications. The first implication is that circularity is not reflected in ING's risk ratings, and the second is that circularity does not appear to result in better financial performance currently. Based on findings in section 2.2, it was expected that increased levels of circularity would result in better financial performance.

There are several reasons that the data collected may not reflect this. First, the quality of data varied for the 6 companies, with several assumptions and estimations needed for several. These assumptions may not fairly reflect the companies' true performance with regards to circularity. Secondly, the sample size used here is very small, with only 6 companies used. Therefore, the data and results from the data analysis needs to be further validated with a larger sample , and further research is needed to discover whether a link between circularity and financial performance currently exists in the construction sector.

Since the data does show that circularity does currently not have an impact on risk in ING's risk assessments, this does provide the opportunity to include circularity, which is be presented in section 7. From section 2 it is understood that embracing circularity is more important than ever in the construction sector, which is the justification for the proposal to include circularity in risk assessments, as companies prepared for the circular economy transition will be more prepared to deal with the changing landscape in the industry, both from a regulation perspective as well as from a supply chain perspective.

## 5.2 Discussion

The findings of this study suggest that circular business models can have lower risks than linear business models (Zara & Ramkumar). This is because circular business models are designed to minimize waste and reduce the consumption of finite resources. By doing so, circular companies are less exposed to supply chain disruptions and raw material price fluctuations. Circular companies are also often more resilient to economic shocks because they rely less on external inputs and can use internal resources more efficiently. This is especially true in resource intensive industries, such as the construction industry.

For example, companies that adopt circular practices, such as recycling and reusing materials, are less vulnerable to disruptions in the supply of raw materials. This is because they are less dependent on virgin materials and have access to alternative sources of raw materials. In addition, circular companies that operate on a closed-loop system are less exposed to market volatility and price fluctuations. This is because they are able to reuse their own materials, reducing their reliance on external suppliers and reducing the risk of price spikes.

However, it is important to note that in some cases, circular business models can also be riskier than linear business models. This is because circular business models often require greater investments in technology and infrastructure. For example, a company that adopts a circular business model may need to invest in new equipment to recycle or reuse materials. This initial investment may be significant and may increase the company's overall financial risk.

In conclusion, circular business models can have lower risks than linear business models in many cases, especially in resource intensive industries like the construction industry. Considering this conclusion, along with the results from the case study in chapter 4, which suggest that circularity is not fairly reflected in ING's risk assessments, support the inclusion of circularity in risk assessments. Lower risk ratings would not only give a fairer reflection of a company's true risk profile and PD, it would also be an additional incentive for construction companies to adopt circular business practices. However, the added risk of the upfront investments required for circular business models need to be considered by ING and other financial institutions when looking at incorporating circularity in risk assessments.

# 6. Conclusion

This thesis looks at the implementation of circularity in the construction industry from the perspective of a financial institution. It investigates the role that financial institutions can have in helping construction companies make the transition to a more sustainable and circular business model. Specifically, it investgates how PD and credit risk are impacted by circularity, and how this can better be reflected in risk rating models utilized at financial institutions. Circular business models are found to be less risky because these businesses can decouple themselves from global supply chains and the high prices that come with it. Considering the resource intensive nature in the construction industry, being reliant on global supply chains and volatile raw material prices can lead to a lot of problems.

Having learnt and studied this apparent de-risking effect of circularity, how circularity can be included in risk ratings at ING was investigated. This was done by first understanding how risk assessments are currently done, followed by finding a way to measure circularity. To measure circularity, several metrics were considered, finally deciding to choose the CTI for several reasons. Having selected a metric, the metric was applied to the construction companies in ING's CSC portfolio, a total of six companies. The results from the CTI was then compared to ING's current risk ratings, to determine whether it's worth including them in risk ratings. If the analysis showed that lower risk companies already performed better in terms of circularity, including a circularity section wouldn't improve the risk rating. This analysis showed that this was not the case, so the recommendation to ING is to incorporate circularity in their risk ratings to both better reflect the true risk rating of construction companies, but also to financially motivate their clients to become more circular, as this will lead to lower risk ratings, which in turn leads to better rates on their loans which can lead to significant savings.

The key takeaways from this thesis are that in many cases, a circular business is faced with less uncertainty than a linear business. There are exceptions to this, but based on existing literature and studies, this is the general trend found. Furthermore, when investigating a range of different metrics, the CTI was deemed most appropriate for financial institutions to use, as it shows how companies are benefitting financially through their circular initiatives. Another key finding is that under ING's current risk ratings, circularity is not reflected in any way, so including circularity would benefit them and construction companies looking to become more circular.

## 6.1 Limitations

One of the main limitations encountered in this project was the time constraints. The research had to be carried out over the course of my contract with ING, which was 4 months.

The typical duration of a bachelor assignment is 10 weeks, which is not enough time to thoroughly investigate every aspect that could be investigated. Furthermore, my contract with ING was 4

months, which proved to be an issue as there was not enough time to contact the construction companies investigated as validation of the findings.

When carrying out calculations for the CTI indicators for the 6 construction companies in ING's portfolio, data availability and quality was an issue. Part of the data needed was available, but for each company the data was in a slightly different format and presented in a different context. This means that assumptions had to be made to complete the calculations, which sheds doubt on the reliability of the results. Despite this limitation, this was the expected result, as circularity isn't included in ING's risk assessments, which was confirmed by an ING employee in the corporate lending department responsible for the construction industry. Since this result was expected by ING employees, the validity of the general results (circularity is currently not reflected in risk assessments) can be trusted despite the assumptions that were made.

Rewrite, saying it was an expected result because circularity not used, but further investigations needed to confirm findings.

As input for the most relevant KPIs to consider and as verification of the findings, the construction companies included in the research population were contacted to schedule interviews. However, only one company responded, meaning that the input for the KPIs was limited. Furthermore, my contract with ING was already over by the time validation of the results was needed, which meant that contacting the construction companies could not be contacted. Therefore, this validation did not take place. However, even if my contract with ING had not expired, considering the lack of responses in the input stage, it's doubtful whether they would have been more responsive in the verification stage. This is nonetheless a limitation, as input from construction companies would have provided more support and confirmation of the findings.

## 6.2 Recommendations

Based on the findings of this study, it is recommended that ING include circularity as a qualitative section in their risk assessments for loans in the construction industry. This is particularly important as the study showed that there is currently no correlation between circularity and risk rating under ING's current risk rating model.

Including circularity as a qualitative section in risk assessments will allow ING to better reflect the risk of the loan and promote circularity in the construction industry. This will involve the identification of more circular companies and giving them lower rates, incentivizing them to adopt more circular practices. This, in turn, will lead to a more sustainable and circular economy. It will also allow ING to better assess the risk of the loan, as companies that adopt circular practices are often more resilient to economic shocks and less likely to experience supply chain disruptions.

To achieve this, ING should provide guidance and support to companies to help them adopt more circular practices. This could include training programs, networking events, and financial support for circular initiatives. This will not only help companies become more circular but will also increase the overall adoption of circular practices in the construction industry.

Finally, it is recommended that ING monitor the effectiveness of their circularity section in risk assessments and evaluate its impact on the construction industry's circularity. This will allow ING to make any necessary adjustments and continuously improve their efforts to promote circularity in the construction industry.

Furthermore, the following recommendations are suggested for further research in order to build upon the findings of this thesis and contribute to the existing knowledge in the field:

Use a wider selection of construction companies: the sample of construction companies used in this study was limited to ING's CSC clients and may not be representative of the broader construction industry. Future research should consider using a wider selection of construction companies of different sizes and from different countries to provide a more comprehensive understanding of the how circularity in the construction industry impacts PD and credit risk.

Study other industries: while this study focused on the construction industry, it is important to recognize that other industries may face similar challenges and opportunities in implementation of circularity and the de-risking effect it presents. Therefore, it would be beneficial to expand the research to other resource intensive industries to compare and contrast circular business practices and determine whether the de-risking effect seen in this research is also seen in other industries.

Perform the research with a more complete data set: this study relied on data collected from annual reports, which had limitations in terms of the completeness of the data. Future research could collect data from other sources such as project documents, project team members, and stakeholders to obtain a more complete set of data and perform the circularity calculations more accurately.

Perform more in-depth research in the statistical link between circularity and the probability of default: while this study has shown that circularity has a statistically significant effect on the probability of default, further research could be done to explore this relationship in more detail. Specifically, more advanced statistical analysis could be performed to investigate the nature and strength of this relationship, including any potential moderating or mediating variables. This would provide a more nuanced understanding of how circularity can impact credit risk and inform the development of more accurate credit scoring models.

By implementing these recommendations, future research can further contribute to the understanding of the circular economy and its impact on credit risk and long-term success in the construction industry and beyond.

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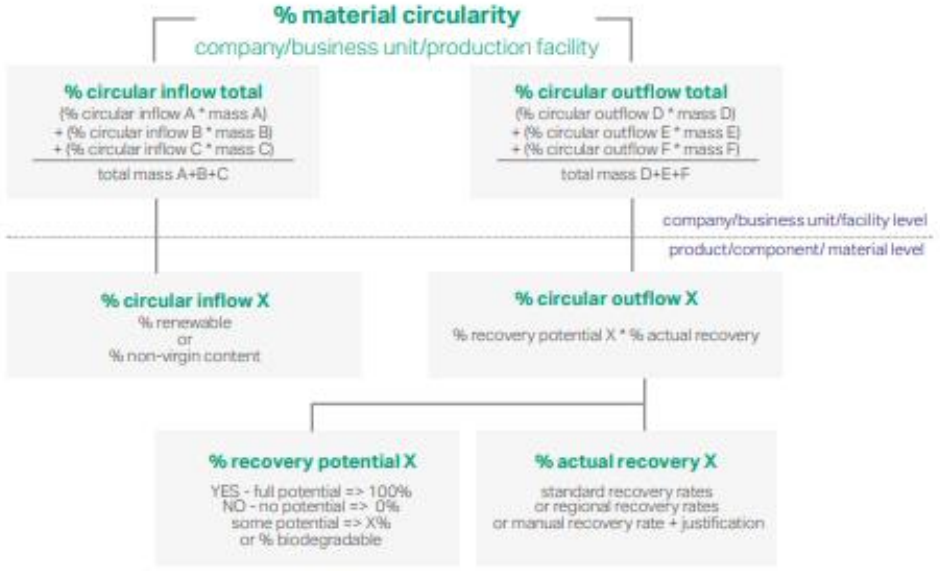
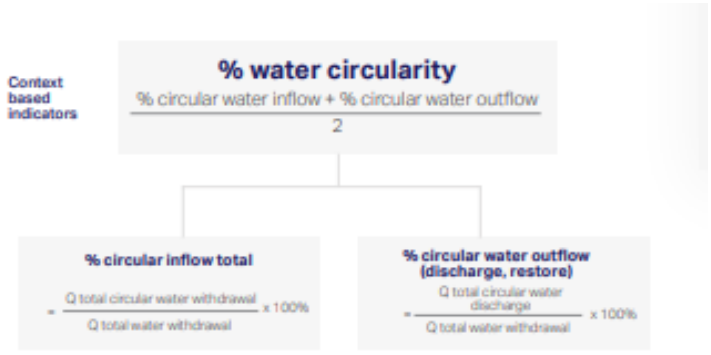
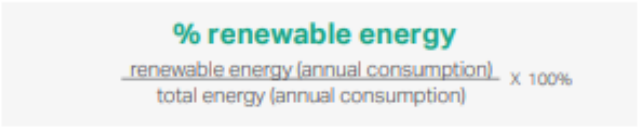
# Appendix A: CTI Manual (World Business Council for Sustainable Development & KPMG, 2022)

Module 1: Close the Loop



Module 2: Optimize the Loop

**% critical inflow**

$$\frac{\text{mass of inflow defined as critical}}{\text{total mass of linear inflow}} \times 100\%$$

**actual lifetime**

$$= \frac{\text{product actual lifetime}}{\text{average product actual lifetime}}$$

Module 3: Value the Loop

**circular material productivity**

$$\frac{\text{revenue}}{\text{total mass of linear inflow}}$$

**CTI revenue (product)**

$$\left[\frac{(\%\ \text{circular inflow} + \%\ \text{circular outflow})}{2}\right] \text{X revenue}$$

**CTI revenue (company)**

CTI revenue A
+CTI revenue B
+CTI revenue C +...

# Appendix B: Circulytics (Ellen MacArthur Foundation, 2022)



## Circulytics Indicators
## Enablers category

*Reminder: This section is skipped for 'Outcomes Only' submissions.*

### Theme 1. Strategy and Planning

WHOLE COMPANY

**1a.**
**How central is circular economy to your CEO's agenda?**

1 Not mentioned in external communications
2 Relevant concept (e.g. materials circulation, a new business model that follows the principles of circular economy, acknowledging that the solution is not just resource efficiency) mentioned in the past 12 months, in external communications
3 Circular economy mentioned explicitly as a strategic priority once in the past 12 months, in external communications
4 Circular economy mentioned explicitly as a strategic priority multiple times in the past 12 months, in external communications

Select Answer

WHOLE COMPANY

**1b.**
**Does your organisational risk management include risks and opportunities related to the transition to a circular economy, and the risks of staying in a linear economy?**

1 No
2 Yes for some parts of the organisation
3 Yes for majority of the organisation
4 Yes for the entire organisation

Select Answer

WHOLE COMPANY

**1c.**
**Is your strategy aligned with becoming more circular?**

1 No relevant mentions of circular economy
2 Relevant concept (e.g. materials circulation, new business models that follow the principles of circular economy, not just resource efficiency) mentioned as part of strategic priorities
3 Circular economy explicitly mentioned as part of strategic priorities

Select Answer





WHOLE COMPANY

**1d.**
**Do you have measurable circular economy targets?**

1 No targets
2 Targets are being developed either for a relevant concept (e.g. materials circulation) or circular economy explicitly
3 Targets have been developed on organisation level, but are not SMART targets
4 SMART targets have been developed on organisation level
5 SMART targets have been developed on organisation level and further down on a sub-unit (e.g. business unit or region) level.

Select all that apply:

each

- ☐ Innovation (incl. R&D; design)
- ☐ Corporate strategy
- ☐ Corporate finance
- ☐ Supply chain management (incl. procurement)
- ☐ Production (plant or process) management
- ☐ Sales and marketing
- ☐ Circular economy/sustainability function or equivalent
- ☐ Other(s) _____

If option 5 write your answers here:

WHOLE COMPANY

**1e.**
**Are the following publicly available (e.g. in an annual report)?**

- Circular economy strategy:

Select Answer

- Measurable circular economy targets:

Select Answer



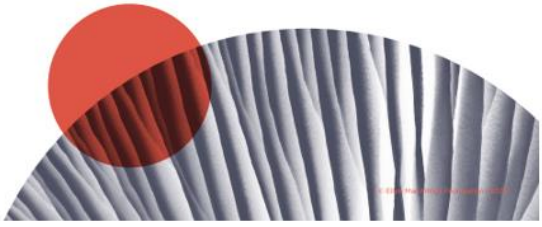


WHOLE COMPANY

**1f.**
**Do you have a circular economy implementation plan?**

1 No
2 An implementation plan is being developed either for a relevant concept (e.g. materials circulation) or circular economy explicitly
3 An implementation plan, which does not go to an actionable level of detail (i.e. does not describe owner, timeline, resource requirements, prerequisites, or potential roadblocks), has been developed
4 A detailed implementation plan has been developed for each relevant function/business unit/region with owner, timeline, resource requirements, prerequisites and potential roadblocks
5 A detailed implementation plan has been developed as a key priority to be (in part) implemented in the next 12 months
6 A circular economy implementation plan has begun implementation and will be periodically reviewed

Select Answer





### Theme 2. Innovation

WHOLE COMPANY

**2a.**
**To what extent is leadership involved in supporting circular innovation/development projects?**

**Empowerment:** Individuals leading innovation projects have the mandate from top management to work on circular economy innovation and regularly report to top management on circular innovation KPIs.

1 Not in place
2 Yes, for at least one innovation project
3 Yes, for majority of innovation projects
4 Yes, for all innovation projects

Select Answer

**Purpose:** Innovation project briefs outline their contribution towards the company-wide circular economy strategy.

1 Not in place
2 Yes, for at least one innovation project
3 Yes, for majority of innovation projects
4 Yes, for all innovation projects

Select Answer

WHOLE COMPANY

**2b.**
**To what extent are tools and metrics in place to support circular innovation/development projects?**

**Tailored circular economy tools** (design guidelines, material selection tools, proof of concept tools, and other resources) are made available to design, sales and marketing, and other relevant teams.

1 Not in place
2 Yes, for at least one innovation project
3 Yes, for majority of innovation projects
4 Yes, for all innovation projects

Select Answer

**Tailored circular economy metrics** developed for specific innovation projects are used to inform and evaluate design choices and are aligned with strategy and planning on circular economy.

0% 1 Not in place
33% 2 Yes, for at least one innovation project
67% 3 Yes, for majority of innovation projects
100% 4 Yes, for all innovation projects

Select Answer

WHOLE COMPANY
WHOLE COMPANY

**2c.**
**To what extent do you collaborate on circular innovation/development projects?**

**External:** Regular collaboration (e.g. with customers, suppliers, reverse cycle operators, start-ups) drives circular innovation.

0% 1 Not in place
33% 2 Yes, for at least one innovation project
67% 3 Yes, for majority of innovation projects
100% 4 Yes, for all innovation projects

Select Answer

**Internal:** Innovation projects are led by multidisciplinary teams throughout the projects' development.

0% 1 Not in place
33% 2 Yes, for at least one innovation project
67% 3 Yes, for majority of innovation projects
100% 4 Yes, for all innovation projects

Select Answer





WHOLE COMPANY
WHOLE COMPANY

**2d.**
**To what extent are different data systems in place to support circular innovation/ development projects?**

**User data:** informs the initial design brief and design choices throughout the projects' development. This includes how data on customers' use of the products/services can be used to inform circular innovation projects. For example, user data for a car manufacturer includes: how customers use and share the vehicle; for how long is the vehicle in operation vs. when it's parked; for how long is the product retained; etc.

0% 1 Not in place
33% 2 Yes, for at least one innovation project
67% 3 Yes, for majority of innovation projects
100% 4 Yes, for all innovation projects

Select Answer

**Systems data:** Data covering the entire product/service journey and the broader system it finds itself in (suppliers, manufacturers, marketers, and social, environmental, and technological trends and impacts) is used to inform design choices. Systems data refers to information, beyond direct customers, that inform circular innovation projects. For example, for a car manufacturer this may include: broader trends in mobility for a circular economy and needs from multiple stakeholders involved.

0% 1 Not in place
33% 2 Yes, for at least one innovation project
67% 3 Yes, for majority of innovation projects
100% 4 Yes, for all innovation projects

Select Answer





# Theme 3. People and Skills

WHOLE COMPANY
SUB-UNIT

**3a.**
**To what extent are your circular economy strategy and implementation plans communicated internally?**

**Bottom up communication** of circular economy initiatives, examples, opportunities
Select all that apply.

- 0% ☐ Internal circular economy case examples communicated using intranet, newsletters, campaigns, etc.
- 0% ☐ Internal feedback channel (which includes circular economy ideas) in use, and has demonstrably led to new circular economy activities or changes to existing activities
- 0% ☐ Circular economy employee platform, community or committee (e.g. to develop internal or external circular economy activities, products, services)
- 0% ☐ Circular economy challenges, such as business plan pitching, etc. where anyone can take part
- 0% ☐ Other (please specify)
- 0% ☐ Other (please specify)

**Top down communication** of circular economy strategy and implementation plans
Select all that apply.

- 0% ☐ Not communicated / circular economy strategy does not exist
- 33% ☐ Conceptual basis of circular economy vision and strategy communicated internally with heads of business units (or equivalent)
- 67% ☐ Implications of circular economy strategy and implementation plans for individual business units (or equivalent) communicated internally
- 100% ☐ As above AND role and responsibility implications communicated internally

WHOLE COMPANY
SUB-UNIT

**3b.**
**To what extent does your company offer circular economy related training within your company?**

*See e.g. the Ellen MacArthur Foundation's From Linear to Circular open programme.*

| | | What type of training is offered? | | |
|---|---|---|---|---|
| | | **General training on circular economy principles and concepts** | **Training on circular economy specific to your industry or business function** | **Formal on the job training (mentorships, trainee programmes, apprenticeships) on circular economy** |
| **How is the training offered?** Note: Each seniority level may have different training focus | **Director and above** [% of score] | Not offered to all [0%] | Select Answer | Select Answer |
| | **Manager** [% of score] | Not offered to all [0%] | Select Answer | Select Answer |
| | **Employee** [% of score] | Not offered to all [0%] | Select Answer | Select Answer |





WHOLE COMPANY
SUB-UNIT

**3c.**
**In which functions do you have individuals or project teams with responsibility for circular economy implementation?**

*Please select or note all that apply, limited to one selection per function.*

| | **No individuals or project teams working on circular economy implementation** 0% per function | **Individuals or project teams working on circular economy implementation during the financial reporting year stated in 0a** 16% per function | **Individuals or teams who have circular economy codified in their job description/ targets/ incentives and are working on circular economy implementation** 25% per function |
|---|---|---|---|
| **Innovation (incl. R&D, design)** | ☐ | ☐ | ☐ |
| **Corporate strategy** | ☐ | ☐ | ☐ |
| **Corporate finance** | ☐ | ☐ | ☐ |
| **Supply chain management (incl. procurement)** | ☐ | ☐ | ☐ |
| **Production (plant or process) management** | ☐ | ☐ | ☐ |
| **Sales and marketing (incl. account management)** | ☐ | ☐ | ☐ |
| **Circular economy/ sustainability function or equivalent** | ☐ | ☐ | ☐ |
| **Other(s) (x5)** | ☐ | ☐ | ☐ |

_____
_____
_____
_____
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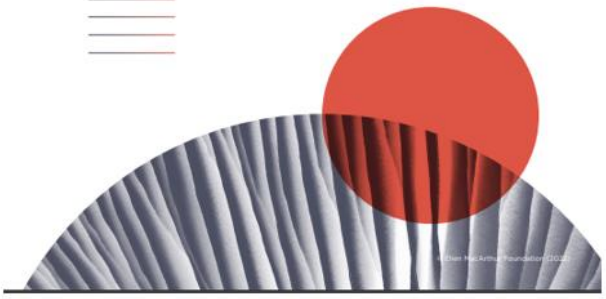


# Theme 4. Operations

WHOLE COMPANY SUB-UNIT

**4a.**
**To what extent is your company implementing digital systems to support circular products or circular services?**

*Please select all that apply:*

- *Such digital systems can be either owned or outsourced.*
- *This includes both internal and client-facing digital systems that are relevant to the delivery of products and services.*
- *Digital systems do not have to be purpose built in order to qualify as 'support circular products or circular services'. Existing digital systems can qualify if they meet the criteria set out in the definitions for circular products or circular services.*

- ☐ Digital systems required to deliver the circular economy strategy have been identified
- ☐ The suitability of all relevant digital systems to support circular products and circular services has been reviewed within the last three financial years
- ☐ Procedural policies have been (re)written for all relevant digital systems to support circular products or circular services, as identified by the last review (within the last three financial years)
- ☐ (Re)design of digital systems has been implemented, as identified in the last review (within the last three financial years), and the systems are now suitable to support the delivery of circular products or circular services
- ☐ At least one pilot case digital system has been reviewed, and relevant procedural policies and (re) designs have been implemented to support circular products or circular services

WHOLE COMPANY SUB-UNIT

**4b.**
**To what extent is your company implementing plant, property, and equipment assets to support circular products or circular services?**

*Please select all that apply:*

- *Such plant, property, and equipment assets can be either owned or outsourced.*
- *This includes both internal and client-facing plant, property, and equipment assets that are relevant to the delivery of products and services.*
- *Plant, property, and equipment assets do not have to be purpose built in order to qualify as 'support circular products or circular services'. Existing plant, property, and equipment assets can qualify if they meet the criteria set out in the definitions for circular products or circular services.*

- ☐ Assets needed to deliver on the circular economy strategy have been identified
- ☐ The suitability of all relevant assets to support circular products and circular services has been reviewed within the last three financial years
- ☐ Procedural policies have been (re)written for all relevant assets to support circular products or circular services, as identified by the last review (within the last three financial years)
- ☐ (Re)design of assets has been implemented, as identified in the last review (within the last three financial years), and they are now suitable to support the delivery of circular products or circular services
- ☐ At least one pilot case asset has been reviewed, and relevant procedural policies and (re)designs have been implemented to support circular products or circular services





# Theme 5. External Engagement

WHOLE COMPANY SUB-UNIT

**5a.**
**To what extent do you engage with suppliers to increase sourcing based on circular economy principles?**

*See additional resource: Ellen MacArthur Foundation circular procurement toolkit*

- *Supplier here includes suppliers of materials / products / plant, property, and equipment assets, as well as suppliers you engage with at the end-of-use or end of functional life of materials / products / plant, property, and equipment assets*

- ☐ No interactions involving circular economy as a topic
- ☐ Ad-hoc interactions involving circular economy as a topic
- ☐ Ongoing programme with one or more of the top five suppliers by mass using circular economy principles
- ☐ Ongoing programme with all of the top five suppliers by mass using circular economy principles
- ☐ Supplier requirements based on circular economy principles, as specified in contracts, are in place with all of your top five suppliers by mass

WHOLE COMPANY SUB-UNIT

**5b.**
**To what extent do you engage with customers on advancing circular economy topics?**

*See additional resource: Ellen MacArthur Foundation How to Communicate Circular Economy toolkit*

- ☐ No interactions involving circular economy as a topic
- ☐ Ad-hoc interactions involving circular economy as a topic (e.g. circular design guide)
- ☐ Ad-hoc interactions involving circular economy as a topic AND a plan in development for an ongoing programme using circular economy principles (e.g. collaboration in communicating the benefits of products and services based on circular economy principles)
- ☐ Ongoing programme using circular economy principles with less than 50% of your customers (e.g. repair programme, product as a service, refill scheme, collection and composting service)
- ☐ Ongoing programme using circular economy principles with more than 50% of your customers (e.g. repair programme, product as a service, refill scheme, collection and composting service)

WHOLE COMPANY SUB-UNIT

**5c.**
**To what extent do you engage with policymakers to support the transition to a circular economy?**

*Inspiration for relevant policy topics is included in the Universal Circular Economy Policy Goals*

- ☐ No interactions involving circular economy as a topic
- ☐ Ad-hoc interactions involving circular economy as a topic (e.g. informing policy makers on circular economy topics)
- ☐ Regular engagement with policymakers involving circular economy as a topic
- ☐ Regular engagement with existing results to accelerate the transition to a circular economy





WHOLE COMPANY SUB-UNIT

**5d.**
**To what extent do you engage with external investors and/or financiers of your company on circular economy topics?**

- *If the company does not have external investors or financiers, 'financiers of your company' may include the owner(s) of the company, or the majority shareholder(s).*

- ☐ No interactions involving circular economy as a topic
- ☐ Ad-hoc interactions involving circular economy as a topic
- ☐ Ad-hoc interactions involving circular economy as a topic AND a plan in development for a programme on circular economy specific financing
- ☐ Ongoing programme on circular economy specific financing (e.g. regular reporting to investors on the business' circular economy impacts or securing favourable lending terms due to circular economy alignment)

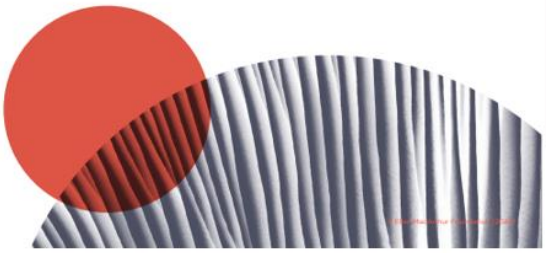
WHOLE COMPANY WHOLE COMPANY

**5e.**
**Do you have a membership of or actively engage with circular economy related initiatives?**

Select 'membership' or 'active engagement' for all that apply:

- *This extends to local community engagement initiatives with programme-level impact monitoring, which raise awareness of and educate on circular economy topics.*

1 Ellen MacArthur Foundation Business Network
2 Platform for Accelerating the Circular Economy (PACE)
3 WBCSD Factor10 Programme
4 GreenBiz Executive Network
5 The African Circular Economy Network (ACEN)
6 The African Circular Economy Alliance (ACEA)
7 European Remanufacturing Council
8 Coalition on Circular Economy (Latin America and the Caribbean)
9 Other (please list)





# Outcomes category

## Theme 6. Products and Materials

*Please refer to the section Company characteristics to find out if your company would be assessed on this theme.*

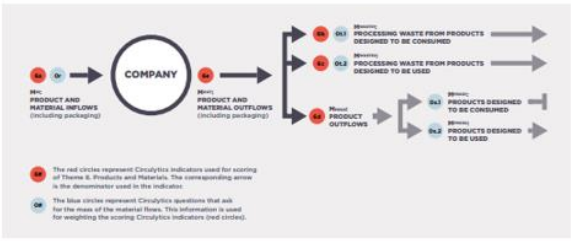



***Figure 2:*** *shows how indicators in Theme 6 assess the material flows entering and leaving the company. Material flows are represented by arrows. To find out which indicators are relevant for your company, please refer to Figure 1.*

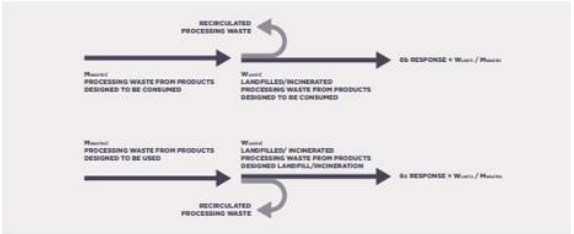



***Figure 3:*** *illustrates how the responses to indicators 6b and 6c are calculated.*

WHOLE COMPANY SUB-UNIT

**6a.**

**What % (by mass) of $M_{IN}$ (from 0r) is:**

- *Please respond on a per-unit of mass basis. For example, products that consist of 50% recycled content would count as 50% non-virgin input. Products that consist of 50% sustainably sourced content would count as 50% virgin but sustainably sourced input.*
- *This indicator excludes materials used for services that are not in company ownership (e.g. servicing IT hardware owned by others).*

100% Non-virgin
(e.g. reused and recycled products and materials)

100% Sourced from by-products/waste streams
(e.g. offcuts of a material that has not previously been in a product)

**Virgin but renewable and regeneratively produced* (evidence required)**

100% • For food, medicine and products for direct human consumption or other products where non-virgin materials are not a legally permitted sourcing option

0% • For product and materials designed to be used (not consumed), where non-virgin materials are a legally permitted sourcing option

**Virgin but renewable and sustainably produced (products and materials that are produced sustainably, but not regeneratively)**

99% • For food, medicine and products for direct human consumption or other products where non-virgin materials are not a legally permitted sourcing option

0% • For product and materials designed to be used (not consumed), where non-virgin materials are a legally permitted sourcing option

0% None of the above (virgin and not sustainably or regeneratively produced)

0% Data not available

*** Regenerative production:**
Regenerative production refers to a range of approaches used to manage agroecosystems that provide food and materials – be it through agriculture, aquaculture or forestry etc. – in ways that create positive outcomes for nature. Positive outcomes include but are not limited to, healthy soils, improved air and water quality, and higher levels of carbon sequestration. They can be achieved through a variety of context-dependent practices and can together help regenerate degraded ecosystems and build resilience on farms and in surrounding landscapes. Farmers may draw on several different schools of thought, such as regenerative agriculture, restorative aquaculture, agroecology, organic, permaculture, agroforestry, and conservation agriculture, to help them apply the most appropriate set of practices to drive regenerative outcomes in their managed agroecosystems.

To claim regenerative production in Circulytics, supporting evidence is required. Examples are:

- Contribution to and use of common on-farm metrics and definitions, tracking progress against the baseline of a healthy ecosystem, while considering local contexts (e.g. alignment with Global Farm Metric, currently under development). Formal certification is not required to claim regenerative production in Circulytics, but supporting evidence needs to be provided of how metrics are used to track regenerative outcomes.
- Certification scheme that includes measurement of regenerative outcomes such as healthy and stable soils, improved local biodiversity, improved air and water quality (e.g. Regeneratively Organic Certified, Demeter).





WHOLE COMPANY SUB-UNIT

**6b.**

**What % (by mass) of $M_{WASTE1}$ (from 0t. Part 1), is material processing waste or by-products that go to landfill or incineration (and are therefore not recirculated)?**

- *This refers to products and materials that go directly from your operations to landfill or incineration and excludes waste generated further down in the value chain (e.g. post-consumer waste).*
- *You should include material flows used in services that are not owned by the company (e.g. by-products from food processing service).*
- *$M_{WASTE1}$ refers to all outflow materials processing waste and by-products that originate from products that are designed to be consumed (e.g. food waste).*
- *Options for keeping these products and materials that are waste or by-products in the economy are composting, anaerobic digestion and other forms of nutrient recirculation (e.g. using fibres extracted from food by-products in textile production).*
- *"Waste or by-products that go to landfill or incineration" here refers to all outflow materials processing waste and by-products that originate from products that are designed to be consumed (e.g. food waste) and are not recirculated while the products and materials are within your company processes ($W_{USE1}$). [6b = $W_{USE1}$ / $M_{WASTE1}$].*

WHOLE COMPANY SUB-UNIT

**6c.**

**What % (by mass) of $M_{WASTE2}$ (from 0t. Part 2) is materials processing waste or by-products that go to landfill or incineration (and are therefore not recirculated)?**

- *This refers to products and materials that go directly from your operations to landfill or incineration and excludes waste generated further down the value chain (e.g. post-consumer waste).*
- *You should include material flows used in services that are not owned by the company (e.g. waste from refurbishing service).*
- *$M_{WASTE2}$ refers to all outflow of materials processing waste and by-products that originate from products that are designed to be used.*
- *Options for keeping these products and materials, that are waste or by-products, in the economy are reuse/redistribution, maintenance/prolonged use, refurbishment/remanufacturing, recycling, or composting and anaerobic digestion.*
- *"Waste or by-products that go to landfill or incineration" here refers to all outflow of materials processing waste and by-products that originate from products that are designed to be used and are not recirculated while the products and materials are within your company processes ($W_{USE2}$). [6c = $W_{USE2}$ / $M_{WASTE2}$].*





WHOLE COMPANY SUB-UNIT

**6d.**

**What % (by mass) of your physical products ($M_{PROD1}$ + $M_{PROD2}$ from 0s. Part 1 and 0s. Part 2) are designed along circular economy principles?**

*Select all that apply and input % (by mass) in the fields below.*

- *Even if a product meets multiple criteria under a category, count each product only once in each category.*
- *Different products can meet different criteria, select all that apply on a company level.*
- *For plastic packaging, please use the Global Commitment definitions.*

**Category 1: During use**

*Products need to be used by your customer - products used in your own operations are categorised as your Plant, Property, and Equipment assets, and covered in **Theme 8**.*

☐ Longevity: Designed for maintenance, longevity and durability in such a way that encourages longer use than the industry standard in practice and at scale (e.g. marketing repair rather than replacement, timeless design with durable material choices) AND in such a way that does not compromise circular treatment at the end of functional life.

☐ Reusability: Designed for multiple uses in such a way that ensures actual reuse in practice and at scale (e.g. secondary markets, packaging reuse systems, standardised design)

☐ Repairability: Designed for repair in such a way that uses existing systems for repair in practice and at scale (e.g. network of repair shops, your own repair service). Examples of design choices are: modular design / built in predictive maintenance sensors, repair diagnostics etc. / designed with right to repair by third parties / designed for remanufacturing / using standardised components across a sector

☐ Regeneratively grown materials of biological origin

*** Regenerative production:**
Regenerative production refers to a range of approaches used to manage agroecosystems that provide food and materials – be it through agriculture, aquaculture or forestry etc. – in ways that create positive outcomes for nature. Positive outcomes include but are not limited to, healthy soils, improved air and water quality, and higher levels of carbon sequestration. They can be achieved through a variety of context-dependent practices and can together help regenerate degraded ecosystems and build resilience on farms and in surrounding landscapes. Farmers may draw on several different schools of thought, such as regenerative agriculture, restorative aquaculture, agroecology, organic, permaculture, agroforestry, and conservation agriculture, to help them apply the most appropriate set of practices to drive regenerative outcomes in their managed agroecosystems.

To claim regenerative production in Circulytics, supporting evidence is required. Examples are:

- Contribution to and use of common on-farm metrics and definitions, tracking progress against the baseline of a healthy ecosystem, while considering local contexts (e.g. alignment with Global Farm Metric, currently under development). Formal certification is not required to claim regenerative production in Circulytics, but supporting evidence needs to be provided of how metrics are used to track regenerative outcomes.
- Certification scheme that includes measurement of regenerative outcomes such as healthy and stable soils, improved local biodiversity, improved air and water quality (e.g. Regeneratively Organic Certified, Demeter).





**Category 2: End of functional life**

☐ Designed for disassembly (e.g. product-component passports, modular design, reversible connections)

☐ Designed for remanufacturing / refurbishment (e.g. modular design)

☐ Designed for recycling (e.g. low materials complexity, low toxicity, ease of separating materials), in such a way that uses existing recycling systems that operate in practice and at scale

☐ Designed for nutrient recirculation that meets the qualifying conditions* (e.g. composting and anaerobic digestion) in such a way that uses systems in practice and at scale

***Qualifying conditions for nutrient recirculation methods:**
1. Other end-of-use options for the material, besides landfill and incineration, have been investigated and found to be not feasible on technical or economic grounds.
2. The material is from a biological source.
3. The material does not cause harm to human health or the environment during or after use and is completely uncontaminated by materials that may cause harm to human health or the environment during or after use (including coatings, preservatives, and fillers, except when these are demonstrably inert and non-toxic, and other materials of biological origin which do not adhere to these qualifying conditions).
4. If energy generation is involved in this process, it should be usefully employed.
5. The products of the process are themselves 100% biologically beneficial (e.g. as a soil conditioner), and are not detrimental to the ecosystems to which they are introduced.

**Category 3: Enabling the circular economy**

*Products and materials that **do not** meet the requirement for circular product design in Category 1 or Category 2, but are designed to enhance/enable circular economy for customers further down the value chain.*

☐ Designed to prevent waste and pollution by customers (e.g. smart waste collection system)

☐ Designed to increase the longevity of other products further down in the value chain in such a way that does not compromise circular treatment at the end of functional life (e.g. replacement parts, repair tools, repair manuals)

☐ Designed to increase recycling yield (quantity and quality) of products further down in the value chain (e.g. materials that separate adhesives from cardboard)

☐ Designed to enable safe return of nutrients to the bioeconomy (e.g. nutrient recovery technology)

☐ Designed to increase the use of renewable energy (e.g. energy storage solutions). Please note that biomass needs to meet certain qualifying conditions to count as renewable energy in Circulytics, as outlined in the Definitions.

| | **% of products applicable to each category:**<br>• *Count each product only once even if multiple principles apply*<br>• *Only categories selected on the previous pages are given the option to provide percentages below* |
|---|---|
| 100% | **BOTH Category 1 and Category 2** |
| 0% | **ONLY Category 1: During use** |
| 0% | **ONLY Category 2: End of functional life** |
| 0% | **ONLY Category 3: Enabling the circular economy** |
| 0% | **None of the above** |

WHOLE COMPANY SUB-UNIT

**6e.**

**Do your product and material outflows (all products, packaging, material processing waste and by-products) ($M_{PROD1}$ + $M_{PROD2}$ + $M_{MAT1E}$ + $M_{MAT2E}$) (sum of Os. Part 1, Os. Part 2, Ot. Part 1, and Ot. Part 2) comply with either of the following chemical restriction lists?**

100% ☐ No substances from the EU REACH Candidate List nor substances from the ChemSec SIN List have been intentionally added at any concentration or are in any material outflows as contaminants in quantities over 0.1% w/w (1,000 ppm)

100% ☐ Material outflows do not contain any substances from the Cradle to Cradle Certified Products Program Restricted Substances List (RSL) in quantities above the maximum allowable concentration (ppm) defined in the list

*Relevant lists: Core List for all material flows; further additions for Biological Nutrients, Children's Products, Formulated Consumer Products, Textiles, Apparel and Jewellery*

0% ☐ No

0% ☐ Data not available

WHOLE COMPANY SUB-UNIT

**6f. Part 1.**

**What % (by mass) of your products and materials ($M_{PROD2}$ from Os. Part 2) are recirculated in practice in the following ways (only counting the first cycle of recirculation after initial use):**

- *Responses to the following options should represent the % of material that is recirculated in practice, rather than the % of material that is designed to be recirculated.*
- *This includes recirculation that is carried out outside of your own company's operations.*
- *Responding accurately to this question may require product / material tracking, particularly if the products are no longer in company ownership.*
- *If you do not have product/material tracking, you should use average recirculation rates for each product/material in the relevant geographies, weighted by mass.*
- *The weighting of each response option depends on whether your organisation operates in an upstream industry, based on the Circulytics industry classification.*

100% Reuse/redistribution

_____

Refurbishment/remanufacture

100% Upstream industry 0% All other industries

_____

Recycling

100% Upstream industry 0% All other industries

_____

Nutrient recirculation that meets the qualifying conditions* (e.g. composting and anaerobic digestion)

100% Upstream industry 0% All other industries

_____

0% None of the above (e.g. landfill, incineration, unintentional loss, any nutrient recirculation that does not meet the qualifying conditions*)

_____

0% Data not available

_____





***Qualifying conditions for nutrient recirculation methods:**

1. Other end-of-use options for the material, besides landfill and incineration, have been investigated and found to be not feasible on technical or economic grounds;
2. The material is from a biological source;
3. The material does not cause harm to human health or the environment during or after use and is completely uncontaminated by materials that may cause harm to human health or the environment during or after use (including coatings, preservatives, and fillers, except when these are demonstrably inert and non-toxic, and other materials of biological origin which do not adhere to these qualifying conditions);
4. If energy generation is involved in this process, it should be usefully employed;
5. The products of the process are themselves 100% biologically beneficial (e.g. as a soil conditioner), and are not detrimental to the ecosystems to which they are introduced.

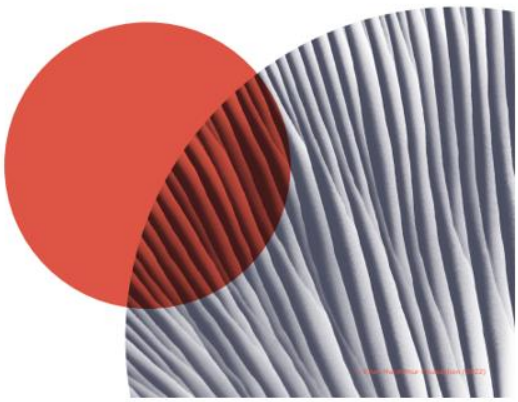
WHOLE COMPANY SUB-UNIT

**6f. Part 2.**

**For all products and materials that are recirculated through reuse in 6f. Part 1., how many average uses do your products have before reaching the end of functional life?**

- *Please give an average, weighted by the mass of each type of product or material.*
- *Please provide a more detailed breakdown of the products and their average number of reuse cycles.*

_____







# Theme 7. Services

*Please refer to the section Company characteristics to find out if your company would be assessed on this theme.*

WHOLE COMPANY SUB-UNIT

**7a. Part 1.**

**What % of your service revenue is from circular services?**

*Input % to all that apply, but do not double count across the responses.*

- *Please note that the scope for this indicator is revenue generating services. For organisations that do have some revenue generating services, any non-revenue generating services (e.g. such as community programs) should not be counted here, but may be applicable to indicator 5e.*
- *For not-for-profit organisations that do not have any revenue generating services, please use funding spent in place of revenue.*

**Consultancy and business support**

- ☐ Advisory services on helping companies transition to a circular way of doing business (e.g. circular strategy development, circular project consultancy, supply chain analysis)
- ☐ Facilitating collaboration between organisations to help transform to a circular way of doing business
- ☐ Consumer/user education on circular economy (e.g. campaigns to explain the value of refurbished products)
- ☐ Design services for circular economy (e.g. product design to increase lifetime, modular design for refurbishing and repair, etc.)
- ☐ Construction services to manage circular built environment projects
- ☐ Regenerative production certification (e.g. Regenerative Organic Certified)
- ☐ Financial advisory services in the context of circular economy

**Software**

- ☐ Sharing, pooling and leasing platforms
- ☐ Virtualisation and digitisation where all material use is avoided, as opposed to being changed from one material to another
- ☐ Predictive maintenance systems
- ☐ Materials or product utilisation tracking
- ☐ Any other digital infrastructure or software that enables circular products and circular services

**Services using products**

- ☐ Product as a service (e.g. furniture leasing)
- ☐ Pay per service unit (e.g. per kilometer of transportation)
- ☐ Regenerative agriculture related service (e.g. service that connects local regenerative farmers directly with restaurants and consumers)
- ☐ Renewable energy utility providers who do not produce the energy themselves (e.g. renewable energy broker)
- ☐ (Packaging) reuse service

**Recirculation**

- ☐ Refurbishing and maintenance (where product ownership does not change)
- ☐ Buy-back and take-back management
- ☐ Waste or wastewater management service
- ☐ Secondary product/material market places

**Other**

Describe your circular economy service here:

_____





| % of your service revenue that is from the following circular services: *Only categories selected on the previous pages are given the option to provide percentages below* | |
|---|---|
| 100% Consultancy and business support | _____ |
| 100% Software | _____ |
| 100% Services using products | _____ |
| 100% Recirculation | _____ |
| 100% Other (description must be given) | _____ |
| 0% None of the above | _____ |

WHOLE COMPANY SUB-UNIT

**7a. Part 2.**

**Select the circular economy principle(s) that the services you highlighted in Part 1 have a positive impact on, and describe the impact.**

*Select all that apply.*

- *This is a prerequisite to scoring any points in 7a, Part 1.*

**Eliminate waste and pollution**

All the services that relate to material or products before they are put on the market and that help a circular economy by designing out waste and pollution from the outset. Service activities that offer, enable or facilitate:

- ☐ Designing (as a service) products with longer use life, reusability, and repairability in mind
- ☐ Addressing material supply/demand imbalances or enabling others to do so (e.g. software for real time manufacturing)
- ☐ Preventing or reducing product waste accumulation (e.g. business support for industrial symbiosis schemes)

**Keep products and materials in use**

All services relating to material or products after they have been used or while in use that help keep materials in the economy, or that help keep the product in use for longer. Service activities that offer, enable or facilitate:

- ☐ Recirculation and valorisation of products and materials that are waste for others (e.g. marketplace for construction waste)
- ☐ New recirculation options for existing products / services (e.g. secondary markets)
- ☐ Sharing materials and/or products (e.g. product as a service)
- ☐ Accessing durable, repairable products
- ☐ Increasing the intensity of use of assets (e.g. utilisation tracking software, asset sharing platforms)
- ☐ Encouraging product maintenance / repair in preference to change in ownership
- ☐ Product / material information accessibility or fidelity in support of circular economy
- ☐ Financial incentives for recirculation of products and materials (e.g. buy-back schemes)

**Regenerate natural systems**

All services that enable keeping nutrients in the (bio)economy, and enhance the health of agricultural and other biological systems the economy relies on. Service activities that offer, enable or facilitate:

- ☐ Sourcing regeneratively and renewably grown material over materials that are not regeneratively grown or finite (e.g. supply chain consultancy)
- ☐ Increasing organic nutrient flow in a defined ecosystem (e.g. organic waste management service)
- ☐ Supporting natural ecosystem processes through improved soil health, biodiversity etc.
- ☐ Reversing degradation of natural ecosystem process in a defined locality (e.g. conservation management, land management)
- ☐ The promotion of renewable energy (e.g. improving the flexibility of the electricity grid, energy storage solutions). Please note that biomass needs to meet certain qualifying conditions to count as renewable energy in Circulytics, as outlined in the Definitions.

Describe your positive impact to circular economy here:





# Theme 8. Plant, Property, and Equipment Assets

- *Every company will be assessed on this theme, independent of responses in the section Company characteristics.*
- *The plant, property and equipment assets used in your company operations (e.g. office buildings and IT equipment) are included in the scope of this theme.*
- *Assets owned by your business but used by customers (e.g. reusable pallets in a product-as-a-service business model) are not included in the scope of this theme.*

WHOLE COMPANY / SUB-UNIT

**8a.**

**For each of the asset groups selected in 0v. Part 2: What % (by mass) of your plant, property, and equipment assets procured in the financial year (as stated in 0a.) were procured with the following circular procurement approaches?**

*(e.g. circular screening criteria, recycled building materials)*

- *Complete this indicator separately for each of the categories you reported number of items for in 8b.*

100% Second-hand assets

New assets designed with the following circular design approaches:

100% • Both during use and end of functional life aspects covered, as defined below

0% • Only during-use (enter the % of assets procured with at least one of the following design approaches):

- Longevity: Designed for maintenance, longevity, durability in such a way that encourages lengthy use in practice and at scale (e.g. designed for repair rather than replacement, timeless design with durable material choices) AND in such a way that does not compromise circular treatment and end of functional life
- Reusability: Designed for multiple uses in such a way that ensures actual reuse in practice and at scale (e.g. secondary markets, packaging reuse systems, standardised design)
- Repairability: Designed for repair in such a way that uses existing systems for repair in practice and at scale (e.g. network of repair shops, your own repair service). Examples of design choices are: Modular design / built in predictive maintenance sensors, repair diagnostics etc. / Designed with right to repair by third parties / Using standardised components across a sector
- Regeneratively grown materials of biological origin
- Recycled content (only count the % mass that is recycled content)

0% • Only end of functional life (enter the % of assets procured with at least one of the following design approaches):

- Leasing model (e.g. assets can be returned at end of use)
- Design for disassembly (e.g. Product-component passports, modular design, reversible connections)
- Designed for remanufacturing / refurbishment (e.g. modular design)
- Design for recycling (e.g. low materials complexity, low toxicity, ease of separating materials), whilst prioritising tighter loops (reuse/redistribute, refurbish/remanufacture, and repair) where possible, in such a way that uses existing recycling systems that operate in practice and at scale
- Designed for nutrient recirculation that meets the qualifying conditions (e.g. composting and anaerobic digestion) in such a way that uses systems in practice and at scale





0% None of the above

0% Data not available

WHOLE COMPANY / SUB-UNIT

**8b.**

**For each of the asset groups selected in 0w. Part 2: Does your company have policies or agreements in place for the end-of-use of existing plant, property and equipment assets (all assets) that enable recirculation in practice?**

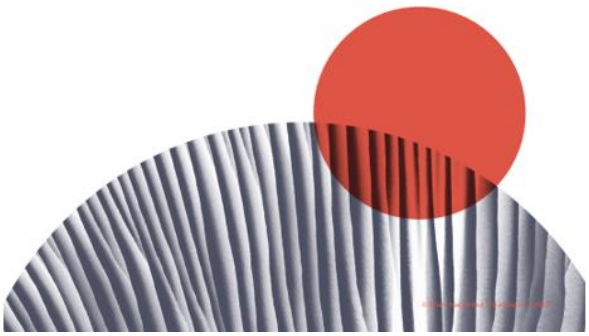
0% ☐ No, and there are no asset recirculation policies or agreements in place

0% ☐ Work is ongoing to create asset recirculation policies or agreements for some / all assets

0% ☐ Yes, we have asset recirculation policies or agreements, but not for all assets

100% ☐ Yes, and all assets are covered by asset recirculation policies or agreements

0% ☐ Data not available





# Theme 9. Water

- *Please refer to the section Company characteristics to find out if your company would be assessed on this theme.*
- *See Appendix of the Method introduction for a guide to the water indicators.*

WHOLE COMPANY / SUB-UNIT

**9a.**

**What % (by volume) of your annual water demand (as stated in 0x. Part 1.) is from each of the following sources:**

100% Precipitation harvesting

100% Cascading use of water (direct use of untreated wastewater, in a manner that is safe for the environment and human health)

100% Internally recirculated water

100% Seawater

100% Non-potable water from freshwater areas that are not classified as water-stressed

0% None of the above (e.g. potable water from freshwater sources, any freshwater sourced from areas classified as water-stressed)

0% Data not available

Depending on your responses to 9a, 9b may be displayed.

- If you withdraw freshwater (i.e. "Non-potable water from freshwater areas that are not classified as water-stressed" or "None of the above" are > 0), you will be displayed 9b on water withdrawal reduction.
- If water withdrawal cannot be calculated based on your responses in 9a (i.e. "Data not available" is > 0), then 9b will not be displayed and scored with 0.
- If you do not withdraw any freshwater, 9b will not be displayed and scored with a full score.

WHOLE COMPANY / SUB-UNIT

**9b.**

This question refers to water withdrawal, which is calculated by the following logic (0x. Part 1. x (Non-potable water from freshwater areas that are not classified as water-stressed % + None of the above %)):

**Which % (by volume) of your water withdrawal have you reviewed for SMART reduction targets?**

WHOLE COMPANY SUB-UNIT

**9c.**
**To what extent do you have plans in place to extract surplus nutrients, metals, chemicals, heat and similar valuable resources before discharging the water used in your processes and operations?**

0% Have not assessed yet

25% Have assessed, currently developing plans

50% Processes in place for some of the water used in operations, or for some of the relevant resources

75% Processes in place for majority of the water used in operations and for majority of the relevant resources

0% Data not available

WHOLE COMPANY SUB-UNIT

**9c (continued).**
**With processes in place to extract surplus nutrients, metals, chemicals, heat and similar valuable resources from water used in operations, are the majority of the extracted resources subsequently recirculated (e.g. through heat exchange, as nutrient recirculation that meets the qualifying conditions, etc.)?**

25% ☐ Yes

0% ☐ No

0% ☐ Data not available

WHOLE COMPANY SUB-UNIT

**9d. What % (by volume) of water annually used in your operations leaves your infrastructure* (as stated in 0x. Part 2.) in the following ways:**

** Including third party monitoring and treatment*

100% For reuse elsewhere (as part of symbiosis, cascading)

100% Fulfilling all of the following requirements:

- After volume monitoring
- AND quality monitoring, ensuring the same or higher quality than the surrounding (healthy) ecosystem,
- AND in the case of original freshwater, to one of the following purposes:
  - recharge local aquifers/groundwater
  - replenish rivers/lakes/wetlands
  - local societal purposes (e.g. drinking water supply)
- AND in the case of original saltwater, back to a saltwater body

0% None of the above, including any water discharge without water quality monitoring and any water discharge without quantity monitoring. Water discharge of original freshwater to a saltwater body also counts towards this response option. This also includes evaporation or spillage

0% Data not available





# Theme 10. Energy

*Please refer to the section Company characteristics to find out if your company would be assessed on this theme.*

WHOLE COMPANY SUB-UNIT

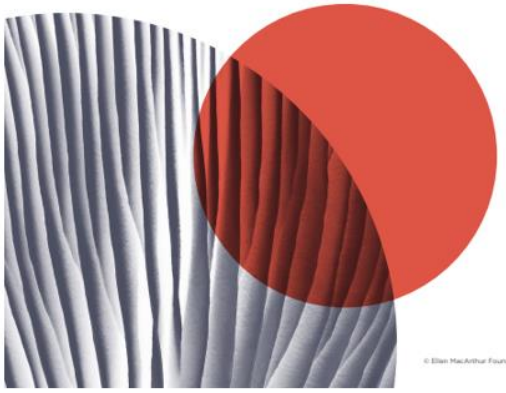
**10a.**
**What % of energy (electricity, heat, and fuel) for your operations (as stated in 0y. Part 1.) is renewable energy?**

- *The scope of this indicator includes energy produced by your company and used in your own operations.*
- *You can use the Unit and Fuel converter to convert your total energy usage into a single unit in order to help calculate your %.*
- *Check the Circulytics Definitions list to verify what qualifies as 'renewable energy'.*

WHOLE COMPANY SUB-UNIT

**10b.**
**What % of the energy you produce (as stated in 0y. Part 2.) is renewable energy?**

- *You can use the Unit and Fuel converter to convert your total energy usage into MWh in order to help calculate your %.*
- *Check the Circulytics Definitions list to verify what qualifies as 'renewable energy'.*







# Theme 11. Finance

*Please refer to the section Company characteristics to find out if your company would be assessed on this theme.*

WHOLE COMPANY SUB-UNIT

**11a.**
**What % of each of the following categories' total in USD (as stated in 0z.) do you screen positively for circular economy alignment?**

*Please refer to the EU taxonomy to assess alignment. In addition to this, we include the production of renewable energy. Please provide a description of how the screening is performed in the comments.*

Lending

Fixed Income

Private Equity

Listed Equity

Other (specify)

WHOLE COMPANY SUB-UNIT

**11b.**
**What % of each of the following categories' total in USD (as stated in 0z.) goes toward financing the circular economy?**

*Please refer to the EU taxonomy to assess alignment. In addition to this, we would include the production of renewable energy.*

Lending

Fixed Income

Private Equity

Listed Equity

Other (specify)